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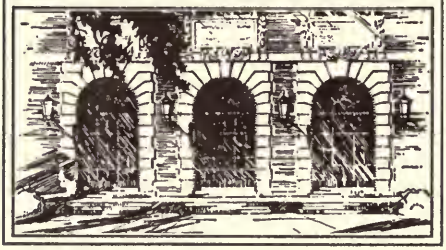

FIELD MUSEUM OF NATURAL HISTORY
PUBLICATION NO. 215
ZOÖLOGICAL SERIES VOL. XV

THE MARINE FISHES OF PANAMA

BY

SETH E. MEEK

Late Assistant Curator, Department of Zoölogy

AND

SAMUEL F. HILDEBRAND

Scientific Assistant, U. S. Bureau of Fisheries

PART I

WILFRED H. OSGOOD
Curator, Department of Zoölogy

CHICAGO, U. S. A.
December 20, 1923

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THE MARINE FISHES OF PANAMA.

BY SETH E. MEEK* AND SAMUEL F. HILDEBRAND.

INTRODUCTION.

The present report is the final paper of a series† by the authors, dealing with the fishes of the Isthmus of Panama. It is based primarily upon the salt water fishes collected along the shores and in the shallower waters during the "Smithsonian Biological Survey of the Panama Canal Zone". The ichthyological reconnaissance during this survey, however, was made cooperatively by the Smithsonian Institution, the Field Museum of Natural History and the U. S. Bureau of Fisheries. A few specimens discussed in the report were contributed by Messrs. H. Pittier and E. A. Goldman of the U. S. Department of Agriculture and very excellent and rather extensive collections were received from Mr. Robert Tweedlie, Canal Commission employee and engineer on a sand dredge operating off Chame Point, who became very much interested in collecting rare and unusual fishes, and who gave the authors valuable assistance during a week's collecting in the vicinity of the dredge. We were also valuably assisted by Mr. E. D. Christopherson, at that time teacher of biology in the Canal Zone Public Schools.

The writers made collections at several points along both coasts of Panama during two seasons, viz., from January to May inclusive, 1911, and from January to March inclusive, 1912. The winter and early spring months were chosen because they represent the dry season in Panama. The work in 1911, however, was well extended into the rainy season. Collecting in fresh water was almost impossible because of the high stage of the streams and collecting marine species became increasingly more inconvenient, as difficulty was experienced in drying nets and in keeping our equipment from deteriorating. The mosquitoes too became very annoying and the work was abandoned on May 22 and resumed the following January.

*Deceased July 6, 1914.

†The previous papers dealt with the fresh water fishes of Panama and were published by the Field Museum of Natural History, Zoological Series, Vol. X, 1912, 1913 and 1916, pp. 67 and 68, pp. 77 to 91 and pp. 217 to 374. The first two papers contain descriptions of new species and the last is a general report which contains a systematic catalogue of the fresh water fishes of the Isthmus so far as known at the time of publication.

All the privileges, and many more, enjoyed by the Isthmian Canal Commission employees were extended to us while on the Canal Zone, which made our work much easier, more pleasant, and much more successful than it otherwise would have been. We, therefore, are deeply indebted to General George W. Goethals and many other officers and employees of the Isthmian Canal Commission. We are also greatly indebted to the Panama Rail Road Company for furnishing free transportation from New York and for a free pass on the railroad on the Isthmus. We wish to extend our gratitude to the various officers of the Smithsonian Institution, the National Museum, the Field Museum of Natural History and the U. S. Bureau of Fisheries who have given us assistance and advice during the preparation of the report. We are particularly grateful to Mr. Barton A. Bean of the Division of Fishes in the National Museum, in whose laboratory the marine collections were studied and where the present report was written. The junior author is also indebted to Mr. William C. Schroeder, scientific assistant U. S. Bureau of Fisheries, for assistance in the study of the sharks and skates and for help in the final details of completing and arranging the manuscript. The illustrations which are presented were in part prepared by Mrs. E. Bennett Decker and in part by Mrs. Louise Nash. The majority of them, as will be seen upon examination, are photographs which have been retouched and improved by the artist.

The senior author, on account of ill health, was obliged to abandon the work before all of the preliminary identifications were completed. His untimely death occurred on July 6, 1914, leaving the completion of the work to the junior author who is solely responsible for final identifications and the report. The withdrawal from the work of the senior author, and the many other duties required of the junior author, greatly delayed the completion of the report, which, it is hoped, will not make the work less useful when it becomes available.

We have had access, during the preparation of the present report, to the very large collection of marine fishes in the National Museum. This has provided much material for comparison which has been of invaluable help in identifying difficult species and in establishing the relationship of many little or imperfectly known ones. The types of many of the species discussed have been available for examination, thus often making our identifications much more certain than they would have been, working with literature alone.

Ichthyological History of the Isthmus of Panama.

The fishes of the Pacific coast of Panama already have been rather extensively studied from the systematist's standpoint, collections having been made, beginning with 1860, by Captain John M. Dow, reported upon by Dr. Theodore Gill and by Dr. Albert Günther. Somewhat later came the reports of Dr. Franz Steindachner, based in part upon his own collections and in part upon specimens received from various correspondents.

In 1881 a large collection was made at Panama City by Dr. Charles H. Gilbert and a second and still larger one in 1883. Unfortunately the latter was destroyed by fire, together with all field notes and manuscript, before an account was published. The deeper waters of Panama Bay, as far out as the Galapagos Islands, were explored by the U. S. Fisheries steamer "Albatross" in 1888 and 1891. The fishes obtained from the "Albatross" expeditions were reported upon by Jordan and Bollman, Gilbert, and Garman.

Panama was again visited by Dr. Gilbert and three associates, in 1896, when 283 marine species were obtained, 43 of which were new. A full account of this collection is contained in "The Fishes of Panama Bay" by Gilbert and Starks, Memoirs of the California Academy of Sciences, Vol. IV, 1904, 304 pages, 33 plates with 62 figures, together with a complete bibliography of all papers, up to the date of publication, dealing wholly or in part with the fishes of Panama Bay and adjacent waters. The authors admitted to their list, in addition to the species collected in 1896, all other species previously reliably reported from Panama Bay, including also species collected by the "Albatross" within the fifty-fathom line.

In 1899 appeared a small paper by Dr. G. A. Boulenger based upon a small collection of fishes made in the Darien region, mostly in fresh water, by Mr. Enrico Feste. A limited number of shore fishes were collected in Panama Bay by the "Albatross" during an expedition in 1904 and 1905, extending from southern California to Peru. These fishes were reported upon by Kendall and Radcliffe, Memoirs of the Museum of Comparative Zoölogy, Vol. XXXV, 1912, pp. 77 to 171, 8 plates.*

The history of collections on the Atlantic coast of Panama is very different, as nothing worthy of mention had been done on that side of the Isthmus. Extensive collections, however, had been made both

*Only a small part of this report deals with the fishes taken in Panama Bay, as all the shore fishes taken on the "Albatross" expedition of 1904 and 1905 are discussed in the paper.

north and south of Panama, i.e., on the coasts of Mexico and Brazil, and also in the West Indies and other islands in or bordering the Caribbean Sea. The species occurring on the Atlantic coast of Panama mostly range a considerable distance northward or southward and, therefore, the great majority of the species were already more or less definitely described.

The Geographical Features of the Coasts of Panama.

The climate of Panama of course is strictly tropical, but, because of cooling breezes, it is rarely oppressively hot. The rainfall, particularly on the Atlantic border, is very heavy, 237.28 inches being recorded for Porto Bello for the year 1909. The dry season occurs during the winter months, viz., from about December to May, the length of the seasons of course varying more or less from year to year. The prevailing direction of the wind is northerly, i.e., from the Atlantic toward the Pacific. During the dry season, at least, there are rather brisk and almost constant northerly trade winds blowing across the Caribbean Sea, causing very choppy water along the Atlantic shores which makes fishing difficult, except in protected places of which there are comparatively few in the vicinity of the Canal Zone. The conditions with respect to winds and sea are apparently more favorable for the fishing industry during the wet season and somewhat better fishing prevails. Panama Bay is rarely choppy, but heavy swells are not uncommon. The conditions for fishing, however, are much more favorable than they are on the Atlantic coast.

The least width of the Isthmus is about 50 miles. The crest of the divide on the Canal Zone is at Culebra, only about 15 miles from the Pacific coast. The highest point in the divide at this place is 665 feet above sea level. Coral formations occur on both sides, but these reefs and shallow water are much more extensive on the Atlantic border than on the Pacific. The shores on the Atlantic are usually low and comparatively large swampy areas, covered with salt or brackish water and largely over-grown with mangrove, are present. The shores on the Pacific, on the other hand, generally are higher, and off shore occur several rather high, and mostly rocky islands. The largest and most important of these is Taboga Island, noted for its excellent fresh water springs, fine pineapples and healthful climate where the *Anopheles,* or malaria mosquitoes, do not thrive. The Isthmian Canal Commission maintained a sanitarium on this island where convalescent patients were sent for recuperation. Good fishing obtains and important collections were made along the shores of this island.

The Pacific coast has excessively high tides, the stage of mean tide being 12.5 feet and spring tide 16.2 feet. When the tide is high comparatively large tide streams, which are practically dry at low water, are formed. The fresh water creeks and rivers too are greatly affected, the current being reversed in their lower courses for many miles. Marine fishes of course follow the tides inland, and often salt water fishes are taken miles from the sea shore.

The effects of the tides on the Atlantic border are negligible, as there is a difference of only about 12 inches in the water level between flood and ebb tide.

Where and How Collections Were Made.

Collections of marine fishes were made on the Pacific coast at the following places—Chame Point, Taboga Island, Balboa and Panama City and nearby islands. Collections also were made from the tide streams near Balboa and Corazal, and several marine species were taken incidentally while collecting fresh water fishes in the rivers. On the Atlantic coast collections were made at Toro Point, in Mindi Cut of the Panama Canal, Cristobal and Colon, and Porto Bello.

The drag net, or seine, was used much more extensively than any other means for catching fish and much the largest portion of the collection was made in that way. Many rare and interesting specimens were purchased in Panama City and Colon fish markets which were frequently visited. By the use of dynamite many species, taken in no other way, were secured. Good results were obtained on the Pacific side by stretching nets across tide streams at high tide, thus closing the passage back to sea, and leaving the fish on the muddy creek beds when the water receded. Set-net fishing was practiced to a very limited extent, and, while fairly successful in catching fish, it could not be used extensively because of the abundance of sharks and crabs which damaged the nets, causing an undue amount of expense and labor for repairs. A limited amount of hook and line fishing was engaged in and only comparatively small number of fishes were taken in that way, but they very often were representatives of species captured by no other method. A small number of species was taken with traps and a few by spearing. Tide pool collecting by the use of poisons was found very productive, particularly on the coral reef at Panama City where many pools remain at low tide. The poisons used were chloride of lime, which was successful, if dissolved before being placed in a pool, and a "larvacide", extensively employed on the Canal Zone for the destruction of mosquito larvæ. The exact ingredients of this

larvacide is not known to us, but it consisted principally of a rather strong alkali with the addition of a small amount of phenol.

It is plainly evident from the results obtained that it is advisable to use many different methods of collecting, if a representative series of the fishes occurring in any vicinity is desired. This is particularly true of localities like the ones occurring on the opposite sides of the Isthmus of Panama where many different kinds of bottom and conditions are present. Some species were taken by a number of different methods, as for example certain *Gerres* and *Scarus* which are extremely abundant on the Atlantic side and occur almost everywhere. Others, however, were taken by only a single method, as for example most of the flounders and soles, the half-beaks and the hound fish or gars which were taken with the seine only. Several species of *Holocentridæ, Pomancentridæ* and *Labridæ* were taken only on coral reefs with dynamite, where of course a seine could not be operated. Many of the sharks, catfishes and eels were taken with hook and line. Mullets *(Mugil)* and snooks or robalos *(Centropomus)* were taken principally in muddy, shallow, and usually more or less brackish water with the set-net. Tide pool fishing yielded many forms taken also by means of dynamite and the seine, but a number of species of gobies, blennies and a few toad fishes and eels were secured which were not taken elsewhere and by no other method.

Mr. Robert Tweedlie, who contributed extensive collections, pursued, for the most part, still different methods of collecting from those employed by the writers, as most of his specimens were either dipped up by the sand dredge which he operated, or taken with the dip-net, often at night under the electric lights, in the vicinity of the dredge. The result was that Mr. Tweedlie obtained 29 species not taken by us, of which 11 are new. His success in acquiring such a large number of species not obtained by the authors is believed to be attributable to the following factors: first, to the methods of collecting which were available and employed; second, to the position of the dredge which was located at the end of Chame Point, a long and very narrow neck of land projecting a distance of about thirty miles into the sea; and third, to the fact that Mr. Tweedlie collected more or less intermittently for a period of over a year, therefore obtaining migratory species which come and go with the season. The writers, as already stated, made nearly all of their collections during the winter months or the dry season.

General Remarks on Distribution.

The fishes of the Pacific coast of Panama generally reach a larger size than those from the Atlantic and the present indications are that a larger number of species also is present. Record is made in the present report of 403 species actually taken in Panama Bay either by us or by other collectors or both, while only 238 species are now definitely reported from the Atlantic coast of the Isthmus. Much more work, however, has been done on the Pacific coast than on the Atlantic, which undoubtedly accounts for a part of the large difference in the number of species now listed from the opposite coasts. The writers, while collecting, divided their time about equally between the Pacific and the Atlantic coast and the same methods of collecting, as far as it was possible to do so, were employed. The result was that 290 species were taken by us on the Pacific coast and 236 on the Atlantic. If the number of species collected by the authors on the opposite coasts during the same season of the year, by almost identical methods and during approximately an equal number of days, only is considered, it then appears as if the difference in the number of species inhabiting the opposite coasts were not as great as indicated by a comparison of the total number of species recorded.

A large number of species is recorded from the Atlantic both north and south of the Isthmus which to date have not been taken on the Panaman coast, although they quite probably all at times frequent it. A comparatively small number of species, on the other hand, is recorded north and south of the Isthmus on the Pacific side which have not already been taken in Panama Bay. No collections, worthy of note, had been made previously on the Atlantic coast and of course our collection is far from exhaustive; neither was it supplemented by a subsequent one like the collection from the Pacific, to which Mr. Robert Tweedlie added many new and rare forms. It certainly is not unreasonable to expect all of those species on the Panaman coasts which already have been reported from localities both north and south of the Isthmus. The number of species recorded from the Atlantic coast of Panama, in that event, would be considerably more augmented than the number now known from the Pacific. The writers, in view of the facts just stated, are of the opinion that future collecting will serve greatly to augment the list of species now reported from the Atlantic coast, but to a much lesser degree the number already reported from Panama Bay. It, however, is not believed that the Atlantic coast of Panama possesses the wealth of fauna which is present on the Pacific coast.

The following table shows that the number of species (157) reported from the Pacific coast, ranging both north and south of the Isthmus of Panama, is much smaller than the number (288)* ranging north and south of Panama on the Atlantic coast. A much larger number (134 species), on the other hand, is known from Panama Bay and northward than the number of species (49)* which is known from the Atlantic coast of Panama and northward. A comparatively small number of species is recorded from the Isthmus which range southward, only 27 species, occurring in Panama Bay and southward, having come to our notice. Eight of these occur in Panama Bay and the Galapagos Islands only, leaving 19 species which are reported from the mainland south of Panama and not north of the Isthmus. We have included 15 species which occur on the Atlantic coast of Panama and range southward. The present report also lists 132 species (including new ones) which appear to have been recorded from Panama Bay only. This number includes approximately 30 species dredged off shore by the "Albatross", within a depth of 50 fathoms, but which have not been taken in the shallow shore waters. The report, on the other hand, lists only 28 species, 26 of which appear to be new, that are known only from the Atlantic coast of Panama.

The data given in the foregoing paragraph, and in the table which follows, indicate that the fishes of the Pacific coast of Panama belong to the North American fauna rather than to the South American. Due allowance, however, must be made for the fact that only comparatively meager collections have been made on the South American coast. The fishes of Ecuador are known to us principally from the brief accounts based upon small collections from Guayaquil by Boulenger (Boll. Mus. Zoöl. Anat. Comp. Torino, Vol. XIII, 1898, pp. 1-3 and Vol. XIV, 1899, pp. 1-8) and by Starks (Proc. U. S. Nat. Mus., 1906, pp. 761-800). The fishes of the Peruvian coast, so far as known, recently have been listed by Evermann and Radcliffe (Bull. U. S. Nat. Mus., XCV, 1917) in a paper based in part upon previous records but mainly upon a collection of fishes made by Dr. R. E. Coker, formerly of the U. S. Bureau of Fisheries. While a number of species previously not known from Peru was added, the list nevertheless must be far from exhaustive, as only 187 species, including several fresh water forms, are recorded. Nearly all the species recorded from Ecuador also occur in Panama Bay, but the Peruvian species are mostly different. The comparatively few species which occur both in Panama and Peru are

*The species which are known from the West Indies, approximately 26, but not definitely recorded from the mainland north of Panama are included.

fishes of wide distribution. Northward the Panaman fish fauna clearly extends to the Gulf of California, as shown by the various papers of Jordan, Gilbert, Evermann, Jenkins, and others, a fact which already has been pointed out by Gilbert and Starks (Memoirs Cal. Ac. Sci., Vol. IV, 1904, p. 205).

The table shows also that a large majority of the species listed from the Atlantic coast of Panama also occurs both north and south of the Isthmus. The species recorded from Brazil in the various lists, based principally upon collections made at Natal, Bahia, and in the vicinity of Rio de Janeiro, are principally Panaman and West Indian species. Berg's "Peces de las Coastas Argentina Y Uruguay (Ann. Mus. Nac. Buenas Aires, Vol. IV, 1895, pp. 1-20), however, contains few species known from the Panaman coast, and those that are common to the coasts of Uruguay and Panama are nearly all species of wide distribution. Northward the Atlantic fauna of Panama plainly ranges to the West Indies, and to southern Florida. Smith's "Fishes of North Carolina" (N. C. Geological and Economic Surv., Vol. II, 1907) contains comparatively few forms listed from Panama. Those species that are common to North Carolina and Panama again are mostly of wide distribution and a few others are stragglers which appear to have drifted northward in the Gulf Stream.

The ichthyological fauna of the Pacific coast of Panama, therefore, appears to range from the Gulf of California to Ecuador and that of the Atlantic from Florida to Brazil.

The close parallelism between the fish faunas of the opposite sides of the Isthmus of Panama and the bearing of this upon the question of a water-way, which formerly existed between the two oceans, has been a subject of discussion by many writers. Gilbert and Starks* say: "From the biological side, the subject is treated in a most satisfactory way by Flaxon (1895)†, with whose views we find ourselves wholly in accord. The ichthyological evidence is overwhelmingly in favor of the existence of a former open communication between the two oceans, which must have become closed at a period sufficiently remote from the present to have permitted the specific differentation of a very large majority of the forms involved. That this differentation progressed at widely varying rates in different instances became at once apparent. A small minority of the species remain wholly unchanged, so far as we have been able to determine that point. A larger number have become distinguished from their

*Memoirs Cal. Acad. Sci., Vol. IV, 1904, p. 205.

†Memoirs Mus. Comp. Zool., Vol. XVIII, 1895, pp. 1-292.

representatives of the opposite coast by minute (but not "trivial") differences, which are wholly constant. From such 'representative forms' we pass by imperceptible gradation to species much more widely separated, whose immediate relation in the past we cannot confidently affirm."

We fully agree with these views, as expressed by Gilbert and Starks, and we have but little to add. However, it has become evident from our studies that fewer species than previously were so considered are common to both coasts of Central America. We have listed 72 species which appear to occur on both coasts, but 48 of these are more or less cosmopolitan in their distribution, i.e., they not only occur on both coasts of Central Amerca but in the eastern hemisphere also. Many of them are not confined to shore waters or even to the tropical seas. Such species, therefore, may migrate from ocean to ocean and they cast no light upon the question of an interoceanic waterway across what is now the Isthmus of Panama. This, then, leaves 24 species which, according to our identifications, are common to both coasts of Central America and can not be distinguished. A direct comparison of specimens from the opposite coasts in many instances was made for the first time and it was found that a comparatively large number of forms, previously considered identical, could be separated by *minute* but *constant* differences. On the other hand, a few forms which had been considered separate and distinct could not be so maintained.

Numerous species have close parallels on the opposite coast. The present collection contains many such forms which were not known or previously improperly defined. In many families nearly every species has a close relative, or parallel, on the opposite side, and future collecting and further study no doubt will reveal many more. Of the 89 families discussed in the present report, 81 have representatives on both coasts. Four small families from the Pacific and four from the Atlantic to date have no representative from the opposite coasts of Panama. Certain families have many more representatives on the one coast than on the other, the *Siluridæ* and the *Sciændæ,* for example, are much more numerous on the Pacific than on the Atlantic, and the species, therefore, cannot in most cases have a parallel on the Atlantic coast. The families, *Sparidæ, Scaridæ* and *Monacanthidæ,* have many more species on the Atlantic than on the Pacific. The reason for such divergence from the more general rule of parallel species is difficult to explain, and several possibilities are open for debate. We advance a single possible explanation which

to us, at least, appears to be the most plausible, viz., that before the last passage between the Atlantic and Pacific oceans was closed to marine fishes, the representatives of certain families already had found that one side of the "divide" was better suited to their peculiar needs than the other. The result, with respect to such families, was that when at last the passageway was completely closed that most of the species of some of them were on one side of the Isthmus, while those of another were on the opposite coast.

TABLE OF DISTRIBUTION.

Pacific Species

Total number of species listed from the Pacific	450
Total number of species actually recorded from Panama Bay	403
Total number of species reported both north and south of Panama Bay	157
Total number of species from Panama Bay and northward only	134
Total number of species from Panama Bay and southward only	27
Total number of species from Panama Bay only	132

Atlantic Species

Total number of species listed from the Atlantic	380
Total number of species actually recorded from the coast of Panama	237
Total number of species reported from the Atlantic both north and south of Panama	288
Total number of species from Panama and northward only	49
Total number of species from Panama and southward only	15
Total number of species from Panama only	28

Identical Species

Total number of species listed which are common to both coasts	72
Total number of identical species actually collected on the coasts of Panama	22
Total number of species more or less cosmopolitan in their distribution	48

Does the Panama Canal Provide a Passageway across the Isthmus for Marine Fishes?

The fresh water species of the opposite slopes of Panama, since the opening of the Panama Canal, can freely intermingle, but the situation, with respect to the marine fishes, is different, for the Panama Canal is not a sea-level canal. At Gatun, about 8 miles from the

Atlantic coast, the canal is provided with locks, consisting of three flights of 15 feet each. Beyond the locks lies Lake Gatun, a large, artificial body of fresh water, made by the construction of a very large dam across the Rio Chagres and part of its valley. This lake is approximately 45 feet above sea level and it extends partly as a broadly expanded body of water and partly confined to the channel of the canal from Gatun to Pedro Miguel, a distance of about 30 miles. Locks with a single flight of 15 feet occur at Pedro Miguel, and below these locks lies another fresh water lake which contains about 3 or 4 miles of the channel of the canal. Then at Miraflores are locks containing two flights of 15 feet each, which bring a ship passing through the canal from the Atlantic to the Pacific back to sea level.

It is, therefore, evident that the Panama Canal provides no passageway from ocean to ocean for strictly marine fishes. However, it does not appear impossible for some of the marine forms which frequent brackish, or even fresh water, such as some of the *Centropomidæ, Gerridæ* and *Gobiidæ,* to endure the fresh water and to find their way from ocean to ocean.

THE COMMERCIAL FISHERIES OF PANAMA.

Nearly all fishing on the coasts of Panama is done at night for two reasons; first, because it is quite generally believed that fish can see the nets during the day and that, therefore, larger catches can be made at night; and second, because the fish must be placed on the markets, which usually are open only in the forenoon, early and disposed of the same day in order to prevent decomposition, as recourse to icing is rarely taken.

Both drag nets and set nets are used, and it is feared that altogether too frequently for the welfare of the fishery dynamite is employed; at least it was during the periods of our visits to Panama. Bamboo traps, such as are also used in the West Indies, are in general use, particularly on the Atlantic coast. The cast net is very common and at times quite successful. Hook and line fishing also is engaged in to a limited extent.

Very few power boats are used, the sail or oar and paddle being depended upon. Most of the boats are of the "dugout" type, which are rather heavy and which capsize easily and must be quite carefully manipulated.

The fishes of the Pacific coast are much more important than those of the Atlantic, as they are much more abundant and generally reach a larger size. The supply at Colon is often insufficient to meet the

local demand and frequently fish are shipped to Colon from the Pacific side. The Pacific fish are at once recognizable in the Colon market, not because the species are very different, for as a rule they are not, but because of their larger average size.

It must be said to the credit of the natives of Panama that they are much less wasteful of their fishes than we are in America. One does not find the shores, where nets are hauled, lined with dead and decaying fish as is the case on the shores of some of our principal hauling grounds. No such waste came to our notice, for practically every species of fish taken is saved and is salable. Sharks, skates, saltwater catfishes, half-beaks, houndfish, or gars, parrot fish, saltwater eels and many others, which are seldom seen in American markets, are sold daily both in the Colon and Panama City markets. Not only small sharks are sold for food, but large ones also, and it is not unusual to see fishermen carry to market on their backs the carcass of a large shark, from which the skin and the internal organs have been removed and which has been cut into halves or quarters after the manner in which beef animals are butchered. The meat of the large sharks is usually sold in slices like steaks. The catfishes appear to find ready sale and at a price which compares favorably with the cost of the better grade of fishes. The groupers, which do not sell well on many American markets, bring the highest prices on the Panama markets. The Spanish mackerels on the other hand are among the cheapest fish.

The Scope of the Catalogue.

The catalogue offered in the following pages not only includes the species taken by us on the coasts of Panama, but also the species recorded from there but not seen by us. Species occurring both north and south of the Isthmus and a few recorded from near Panama, either north or south, and which may be expected on the Panaman coasts have also been included. Similarly, we have admitted a number of species more or less cosmopolitan in their distribution, although not yet taken on the Isthmus. We follow Gilbert and Starks "Fishes of Panama Bay" (Memoirs Cal. Ac. Sci., IV, 1904) in admitting to our list the species dredged in Panama Bay by the "Albatross" within the 50-fathom line. Several of the species taken off shore by the "Albatross," however, do not appear to frequent the shallow shore waters and perhaps do not properly belong to the shore fishes.

Comparatively few species (5) of the family *Gerridæ* known from American waters have not been taken on the coasts of Panama. It was found necessary to study all the American species of this family

in order to understand their true relationships and in this instance all the species studied have been included.

Two species of eels, *Synbranchus marmoratus* Bloch and *Anguilla rostrata* (Le Sueur), both belonging more properly to the fresh water fauna, but which were overlooked when the report on the fresh water fishes of Panama was prepared, have been included in the present work.

Descriptions are offered (with a few exceptions) of the species listed which, as far as possible, are based on specimens. It seemed advisable to draw up new descriptions, as many of those in our current works are very imperfect and unreliable. Many of them of course were based upon a single or very few specimens, which sometimes were in a bad state of preservation and all of one size and no allowance for variation with age, therefore, was made. Many closely related or identical species of the opposite coasts of Panama have now been compared for the first time and special effort has been made to show the relationship of those species. The proportions given in the various descriptions are based upon measurements accurately made with calipers and slide rule. Not fewer than six specimens, if that many were available, and more usually a larger number, especially if the relationships were close or doubtful, was measured. As wide a range as possible in size of the specimens selected for measuring was usually chosen in order to get the variations in proportions occurring with age. The counts of fin rays, scales, gill-rakers, etc., were based upon similar series.

EXPLANATORY NOTES.

It has been the general plan to give for each species, in a brief synonymy, the name exactly as offered by the discoverer, also the type locality, and all other names that have become synonyms, together with references to literature of local interest and usually one or more references to a more or less general work on the classification of fishes. Thereafter follows a description—which has been drawn up with the view of giving the characters of the species briefly, yet complete enough to show its relationship to other species. An attempt is made throughout the work to mention characters in the same sequence in each description.

Certain abbreviations adopted by other writers have been followed. For example, the expression "Head 2 to 3.5; depth 3 to 3.8" signifies that the length of the head measured from tip of the upper jaw to the bony margin of the opercle (unless otherwise specified) is contained 2 to 3.5 times in the "standard length," i.e., in the distance

from the end of the snout to the base of the caudal fin, and the greatest depth of the body is contained 3 to 3.8 times in the standard length. Roman numerals have been adopted for the spines and Arabic numerals for the soft rays in giving fin formulæ. For example, D. IV-I, 16; A. II-8 signifies that in this instance the dorsal fins are separate, the first consisting of four spines and the second of one spine and sixteen soft rays and the anal fin is preceded by two separate spines and the remainder of the fin consists of eight soft rays. When the spines and soft rays are all connected and form single fins the formulæ are written thus, D. V, 16; A. II, 8. The number of scales given, unless otherwise stated, is the number of oblique rows occurring just above the lateral line, from the upper angle of the gill opening to the last series of large scales on the base of the caudal.

After each description mention is made of the size of the specimens at hand, if any, upon which the description was based, in order that the reader may know whether the characters as described are applicable to old or young individuals or both. In the final paragraph, after the description, we have endeavored to give the distribution and the Panama field stations at which specimens were taken.

In the arrangement of the families* we follow Jordan and Evermann's "The fishes of North and Middle America" (Bull. U. S. Nat. Mus., XLVII, 1896-1900). In order to render the catalogue useful for ready identification, keys to the families, genera and species have been introduced. The keys are simply intended to facilitate identification and no attempt is made to indicate the natural characters or relationships of the various groups and only the families, genera and species coming within the scope of the present work have been taken into consideration. In using the keys, first determine to which of the major groups the species in hand belongs, then take up the regular order of letters under that group. If the characters of the specimen do not agree with those under the single letter, look under the double letter, ignoring all intervening matter.

Key to the Families.

No attempt has been made to group the large divisions, viz., the classes and orders, but each is given with a short definition and in the sequence in which the species occurring under these divisions are reviewed in the text. The key, therefore, really consists of a series of keys for the families occurring under the various orders represented.

*Jordan's "A Classification of Fishes" (Leland Stanford Jr. Univ. Pub., Univ. Ser., III, 1923) became available too late to admit of its use in the present work.

I. LEPTOCARDII (the lancelets): Animals with a cartilaginous skeleton and without brain or skull; body elongate, compressed; mouth a mere slit; heart a tubular vessel, without separate chambers; blood colorless. *Branchiostomidæ*, p. 27.

II. ELASMOBRANCHII (sharks, skates and rays): Animals with cartilaginous skeleton, with an imperfectly developed skull, and with a brain; gill-openings numerous (5 to 7) and slit-like, the gills attached to the skin; skin naked or covered with small rough scales, spines or tubercles; air bladder absent; the jaws separable from the skull.

1. ASTEROSPONDYLI (the typical sharks): Body typically fish-like; pectoral fins not attached to the head.

a. Nictitating membrane present; spiracles absent or present.

b. Teeth more or less compressed, triangular, one or two series functioning.

c. Head normally shaped, not expanded across orbital region, not hammer-shaped. *Carcharhinidæ*, p. 35.

cc. Head greatly expanded across orbital region, more or less hammer-shaped. *Cestraciontidæ*, p. 57.

bb. Teeth depressed, paved, several series functioning. *Galeorhinidæ*, p. 31.

aa. Nictitating membrane absent; spiracles present.

d. First dorsal inserted over ventrals; nostrils with a nasoral groove and with a prominent cirrus or barbel. *Orectolobidæ*, p. 29.

dd. First dorsal inserted in advance of ventrals; nostrils without nasoral groove or cirrus.

e. Caudal fin very long, longer than body; sides of caudal peduncle not keeled; last gill-slit above base of pectoral. *Vulpeculidæ*, p. 62.

ee. Caudal fin not excessively long, more or less lunate, with a keel on each side; last gill-slit entirely in front of base of pectoral. *Isuridæ*, p. 63.

2. CYCLOSPONDYLI (the dog-fishes): Anal fin absent; two dorsals, each with a spine.

a. Spiracles present; mouth with labial folds; no nictitating membrane. *Squalidæ*, p. 64.

3. BATOIDEI (the skates and rays): Head and body much depressed; pectoral fins greatly expanded and confluent with the head, forming with the head and body a more or less definite disk; gill-openings all inferior.

a. Tail comparatively thick, bearing 2 dorsals and a caudal fin; no serrated caudal spine.

b. Nasoral groove absent; disk narrow and elongate; tail strong.

c. Snout saw-like, much produced, flat, armed with strong lateral teeth set at right angles to its axis; disk small. *Pristidæ*, p. 65.

cc. Snout more or less produced, not saw-like, toothless; disk of moderate size; pectorals continued to sides of head, not reaching end of snout. *Rhinobatidæ*, p. 67.

bb. Nasoral groove present; disk broad, rounded or angular; tail moderate or short.

d. Disk subcircular; skin smooth; an electric organ on each side of median line of head. *Narcaciontidæ*, p. 72.

dd. Disk rhomboidal; skin usually rough, with spines or tubercles; no electric organs. *Rajidæ*, p. 70.

aa. Tail slender, with one or no dorsal fin and usually with one or more serrated spines.

e. Pectoral fins uninterrupted, confluent around the snout; teeth small; disk subcircular to rhomboidal. *Dasybatidæ*, p. 75.

ee. Head bearing one or a pair of rostral processes or cephalic fins, representing a partly or entirely separated section of the pectoral fins; disk very broad and angular.

f. Head bearing one or a pair of rostral processes; teeth large, flat, hexangular, the middle ones usually broader than the outer ones. *Myliobatidæ*, p. 88.

ff. Head bearing 2 long, horn-like appendages; teeth small, numerous, arranged in pavement. *Mobulidæ*, p. 92.

III. TELEOSTOMI (the bony fishes): Animals with bony skeleton, with a well developed skull with sutures and membranous bones; gill-opening a single slit on each side, the gills attached to bony arches; skin usually with numerous flat scales; air bladder present or absent; the jaws not distinct from the skull.

1. Nematognathi (the catfishes): Parietals and supraoccipital confluent; 4 anterior vertebræ co-ossified; no true scales, body naked or with bony plates; anterior part of head with 2 or more whiskers or barbels.

a. Body wholly naked (in Panama species); adipose fin present; mouth terminal, with 4 to 8 barbles; dorsal and pectoral fins each with a strong spine. *Siluridæ*, p. 95.

2. SYNBRANCHIA* (the synbranchoid eels): Body eel-shaped; premaxillaries well developed; scale minute or wanting; no paired fins; vertical fins reduced to folds of skin; vent at a great distance from head.

a. Shoulder girdle connected to the skull by a bony posttemporal; tail longer than rest of body; palatine teeth in a band; gill-openings small, confluent, inferior; gills 4; scales wanting. *Synbranchidæ*, p. 131.

3. CARENCHELYI (the long-necked eels). Body very elongate, snake-like; maxillaries and premaxillaries developed; branchial apparatus as in Apodes.

a. Mouth rather large, oblique; jaws well developed; tongue largely free anteriorly; eyes lateral in anterior half of head; anterior pair of nostrils entirely above upper lip, not tubular; scales wanting. *Derichthyidæ*, p. 132.

4. APODES (the eels): Body very elongate, more or less snake-like; premaxillaries rudimentary or wanting; vertebræ in large number; ventral fins wanting; no spines in the fins; gill-openings comparatively small.

a. Skin covered with rudimentary, embedded scales, placed at right angles to each other; mouth terminal or nearly so; teeth in bands on jaws and vomer; dorsal fin continuous with the anal around the tails. *Anguillidæ*,† p. 134.

aa. Scales wholly wanting.

b. Gill-openings well developed; tongue present; pectoral fins more or less developed; scapular arch present.

c. Tip of tail with a more or less distinct fin, the dorsal and anal confluent around it.

d. Posterior nostril not labial, situated entirely above the upper lip; body moderately slender, but not worm-like.

e. Tongue broad, largely free in front; vomerine teeth moderate. *Leptocephalidæ*, p. 135.

ee. Tongue rather narrow, largely adnate to the floor of the mouth; vomerine teeth well developed, sometimes enlarged. *Muræsocidæ*, p. 141.

*This order should have been included in our report on the fresh water fishes of Panama (Field Mus. Nat. Hist. Pub., Zoöl. Ser., Vol. X, 1916, pp. 217 to 374) but it was overlooked when the report was prepared.

†This family more properly should have been included in our report on the fresh water fishes of Panama (Field Mus. Nat. Hist. Pub., Zoöl. Ser., Vol. X, 1916, pp. 217 to 374), since the species spend most of their lives in fresh water, but it was inadvertently overlooked when that report was prepared.

dd. Posterior nostril situated either in the upper lip or very near it; body more or less worm-like. *Myridæ*, p. 145.

cc. Tip of tail without the rudiments of a fin, projecting beyond the dorsal and anal fins, usually ending in a rather sharp, horny point. *Ophichthyidæ*, p. 147.

bb. Gill-openings small; tongue wanting; pectoral fins entirely wanting; scapular arch obsolete; skin thick, leathery; color usually variegated. *Muræniдæ*, p. 160.

5. Isospondyli (the clupeoid and salmonoid fishes): Anterior vertebræ simple, unmodified; opercular bones distinct; gills 4, a slit behind the fourth; dorsal and anal fins without true spines; adipose fin present or absent (absent in Panama species); ventral fins abdominal, sometimes wanting.

a. A bony plate between the arms of the lower jaw. *Elopidæ*, p. 173.

aa. No plate between the arms of the lower jaw.

b. Lateral line present; tongue and base of skull with patches of coarse, blunt teeth. *Albulidæ*, p. 177.

bb. Lateral line wanting; tongue and base of skull without patches of coarse, blunt teeth.

c. Mouth moderate, terminal, usually more or less oblique. *Clupeidæ*, p. 179.

cc. Mouth large, inferior, usually horizontal, the snout overhanging the mouth; mandible long and slender. *Engraulidæ*, p. 195.

6. Iniomi (the lizard fishes): Anterior vertebræ simple, unmodified; opercular bones sometimes imperfectly developed; gills 4, a slit behind the fourth; dorsal and anal fins without true spines; adipose fin present or absent (present in Panama species); ventral fins if present, abdominal.

a. Adipose fin present; mouth very large; scales usually present, cycloid; lateral line present; caudal fin forked. *Synodontidæ*, p. 215.

7. Synentognathi (the needlefishes, half-beaks and flying fishes): Vertebræ numerous, the abdominal ones much more numerous than the caudal; lower pharyngeal bones fully united; fins without spines; ventral fins with more than 5 spines; no adipose fin.

a. Both jaws greatly produced, forming a long beak; each jaw with a band of short pointed teeth to end of beak; pectoral fins normal. *Belonidæ*, p. 223.

aa. Upper jaw short, the lower greatly produced (in Panama

species); no teeth on produced part of lower jaw; pectoral fins normal. *Hemirhamphidæ*, p. 232.

aaa. The jaws not produced into a beak; pectoral fins greatly enlarged, used as organs of flight. *Exocœtidæ*, p. 241.

8. HEMIBRANCHII (the trumpet-fishes): Interclavicles well developed; gills pectinate; snout usually more or less produced (greatly produced in Panama species); the small mouth placed at end of snout; mouth bounded above by premaxillaries only; fins with or without spines (without spines in Panama species); ventral fins abdominal or subabdominal.

a. Head very long, the anterior bones of skull much produced, forming a long tube; scales wanting, replaced by bony plates on the back, on sides, and on chest. *Fistulariidæ*, p. 248.

9. LOPHOBRANCHII (the pipe-fishes): Interclavicles well developed; gills tufted; snout greatly produced, bearing at the end the very small mouth, bounded by premaxillaries; teeth wanting; skin with bony plates; fins with soft rays only.

a. No spinous dorsal; no ventral fins; gill-openings narrow; body covered with more or less definite bony rings. *Syngnathidæ*, p. 254.

10. ACANTHOPTERI (the spiny rayed fishes): Interclavicles wanting; gills laminated, i.e., in series, one lying next to the other; mouth bordered by premaxillaries; maxillary usually distinct, but sometimes co-ossified with the premaxillaries; opercular apparatus complete; pectorals always present; ventrals rarely wanting, typically with 1 spine and 5 soft rays; dorsal and anal fins typically anteriorly with spines or simple rays, but sometimes the rays are all articulated.

A. Ventral fins present, abdominal.

a. Dorsal fins 2, the anterior composed of spines only, the posterior chiefly of soft rays.

b. The lowermost rays of pectorals free and filamentous. *Polynemidæ*, p. 288.

bb. Pectoral fins entire, no free rays.

c. Head normal, not pike-like; the jaws not much produced, rather weak; teeth small or wanting; lateral line obsolete.

d. First dorsal with 3 to 9 flexible spines; anal fin with a single weak spine. *Atherinidæ*, p. 262.

dd. First dorsal with 4 stiff spines; anal fin with 3 stiff graduated spines (2 in very young). *Mugilidæ*, p. 273.

cc. Head long, pike-like; jaws long and strong; teeth strong, unequal; lateral line present. *Sphyrænidæ*, p. 282.

AA. Ventral fins present, thoracic or subjugular, definitely with I, 5 rays.

a. Ventral fins well separated, never united.

b. Suborbital with a bony stay extending across cheek; cheek sometimes entirely mailed.

c. Pectoral fins with 3 lower rays detached; head bony. *Triglidæ*, p. 847.

cc. Pectoral fins entire, none of the rays detached.

d. Dorsal with 4 or 5 spines, these occasionally wanting (wanting in *Katheostoma*); eyes small, superior, looking up; lips fringed. *Uranoscopidæ*, p. 906.

dd. Dorsal with 8 to 16 spines, eyes moderate, lateral; lips not fringed; anal spines 3; head large, with prominent ridges, terminating in spines. *Scorpænidæ*, p. 832.

bb. Suborbital stay wanting; cheeks not mailed.

e. Top of head with a large sucking disk, composed of several crosswise partitions or laminæ and a single lengthwise septum. *Echeneididæ*, p. 894.

ee. Head without a sucking disk.

f. Some or all of the dorsal or anal spines more or less disconnected, the former depressible in a groove.

g. Body very elongate, more or less spindle-shaped; head depressed; dorsal with 8 or 9 free spines. *Rachycentridæ*, p. 403.

gg. Body oblong or ovate, compressed.

h. Anal fin preceded by 2 free spines (these obsolete in very old, joined by membrane in very young); ventral fins normal; œsophagus normal, without teeth.

i. Preopercle entire; teeth, if present, moderate; caudal fin very broadly forked, the peduncle slender. *Carangidæ*, p. 331.

ii. Preopercle serrate, teeth in jaws unequal, some of them much enlarged; caudal fin moderately forked, the peduncle moderately stout. *Pomatomidæ*, p. 401.

hh. Anal fin long, similar to dorsal, not preceded by free spines, with 3 or more connected spines; ventral fins normal in young, sometimes reduced or wanting in adult; œsophagus provided with lateral sacs which are toothed internally. *Stromateidæ*, p. 407.

ff. Dorsal spines, if present, all or nearly all connected by membrane.

j. Dorsal and anal each followed by a series of detached finlets; anal fin not preceded by free spines; caudal peduncle with prominent lateral keel; caudal fin broadly forked.
Scombridæ, p. 307.

jj. Dorsal and anal without finlets.

k. Caudal peduncle armed laterally with a strong lancet-like spine; gill-openings restricted to the sides, the membranes attached to the isthmus. *Hepatidæ*, p. 779.

kk. Caudal peduncle unarmed.

l. Throat with 2 long unbranched barbels attached just back of symphysis of lower jaw. *Mullidæ*, p. 302.

ll. Throat with long barbels.

m. Nostrils single on each side; lateral line not complete, ending under soft dorsal; anal with 2 spines. *Pomacentridæ*, p. 693.

mm. Nostrils double on each side.

n. Lateral line extending to tip of middle rays of caudal.

o. Anal spines 3, the second very strong; dorsal fins separate.
Centropomidæ, p. 419.

oo. Anal fin with 1 or 2 spines, the second moderate or small; dorsal fin deeply notched or more or less separate.
Sciænidæ, p. 610.

nn. Lateral line not extending beyond base of caudal (except in a few species of *Hæmulidæ*).

p. Gills 3½, the slit behind the last very small or wanting.

q. Teeth in jaws nearly or quite distinct, separate, some of the anterior ones more or less enlarged, canines.
Labridæ, p. 708.

qq. Teeth in jaw coalesced on sides, usually forming a continuous cutting edge, with an evident median suture.
Scaridæ, p. 731.

pp. Gills 4, a long slit behind the fourth.

r. Teeth setiform, like the teeth of a brush, or at least very slender, movable; body short and deep; soft fins completely scaled; gill-membranes attached to isthmus.

s. Dorsal fins rather deeply notched or divided; teeth slender, but scarcely bristle-like. *Ephippidæ*, p. 759.

ss. Dorsal fins continuous; teeth numerous, slender, bristle-like.
Chætodontidæ, p. 764.

rr. Teeth not very slender or bristle-like, usually fixed; gill-membranes free from the isthmus or nearly so.

t. Premaxillaries excessively protractile, their basal processes very

long, entering a groove at top of cranium just underneath the skin; scales large, silvery; spines strong. *Gerridæ*, p. 581.

tt. Premaxillaries moderately protractile, or not protractile.

u. Lateral line incomplete, running close to dorsal fin; dorsal spines very slender, continuous with the soft rays; anal fin very long, with about 18 to 20 rays. *Opisthognathidæ*, p. 899.

uu. Lateral line, if present, complete.

v. Dorsal fin very long, beginning on head, with about 50 to 60 rays, no definite spines; caudal fin widely forked; anal fin shorter. *Coryphænidæ*, p. 405.

vv. Dorsal fin shorter, not beginning on head, anteriorly with spines.

w. Anal spines 2, rarely 3 or 4 (2 in Panama species); dorsal fins well separated, the first with 3 to 9 spines; scales large. *Cheilodipteridæ*, p. 414.

ww. Anal fin with 3 spines; dorsal fin continuous or rarely divided (continuous in Panama species).

x. Maxillary not sheathed by the preorbital or only partly sheathed; opercles usually ending in 1 or 2 flat spines.

y. Vomer without teeth; dorsal fin continuous; body deep, compressed. *Lobotidæ*, p. 483.

yy. Vomer and usually palatines also with teeth.

z. Anal fin nearly as long as dorsal and similar to it; head and body everywhere with rough scales; body rather deep, compressed; post-ocular part of head shortened. *Priacanthidæ*, p. 486.

zz. Anal fin shorter than dorsal; head not everywhere covered with rough scales; body usually quite elongate and generally more or less compressed; post-ocular part of head not shortened. *Serranidæ*, p. 434.

xx. Maxillary slipping for the most part under the preorbital and more or less completely shielded by the latter; opercle without spines.

a′. Teeth on the jaws not all incisors; alimentary canal comparatively short; carnivorous fishes.

b′. Vomer with teeth, these sometimes very small; teeth in the jaws usually unequal, some of them more or less canine-like. *Lutianidæ*, p. 490.

bb′. Vomer without teeth.

c′. Teeth on sides of jaws not molar-like, all pointed and no marked canines; preopercle usually serrate. *Hæmulidæ*, p. 520.

cc'. Teeth on sides of jaw molar-like, the anterior teeth conical or more or less incisor-like; preopercle entire. *Sparidæ*, p. 571.

aa'. Teeth on anterior part of jaws incisors, no molars or canines; alimentary canal very long; herbivorous fishes. *Kyphosidæ*, p. 604.

aa. Ventral fins either very close together or more usually united, forming a sucking disk, or at least a part of a sucking disk situated between them.

d'. Gills 4; dorsal fins 2, separate or more or less united. *Gobiidæ*, p. 861.

dd'. Gills 2½ or 3; dorsal fin single, without definite spines. *Gobiesocidæ*, p. 925.

AAA. Ventral fins present, thoracic or jugular, the number of rays not definitely I, 5.

a. Eyes symmetrical, one on each side of head.

b. Ventral fin with or without spine, with more than 5 rays.

c. Body covered with firm, strongly serrated scales; dorsal with about 11 strong spines, none of them filamentous; anal fin with 4 strong spines. *Holocentridæ*, p. 293.

cc. Body covered with rather small cycloid scales; dorsal with 8 long, slender spines, filamentous (except in very young); anal fin with a single, slender spine. *Nematistiidæ*, p. 329.

bb. Ventral fins with or without spine, with fewer than 5 rays.

d. Dorsal fin consisting of spines only, or partly of spines, or at least partly of simple, unbranched rays.

e. Pectoral fins divided into 2 parts, the anterior part nearly as long as head, composed of about 6 rays, the other part produced, reaching nearly to base of caudal in adult (shorter in young), used as organs of flight. *Cephalacanthidæ*, p. 859.

ee. Pectoral fins not divided.

f. Dorsal with 2 to 4 spines; gills 3, the membranes broadly united to the isthmus; head broad, depressed; ventral fins with I, 2 or I, 3 rays. *Batrachoididæ*, p. 910.

ff. Dorsal spines or simple rays usually numerous (10 or more in Panama species); gills 4.

g. Gill-membranes separate, free from the isthmus; opercles and lips fringed; eyes superior. *Dactyloscopidæ*, p. 901.

gg. Gill-membranes usually more or less united to the isthmus; opercles and lips not fringed; eyes rarely superior.

h. Gill-openings not reduced to horizontal slits below and in advance of pectorals. *Blenniidæ*, p. 928.

hh. Gill-openings reduced to small, more or less horizontal slits below and in advance of pectorals. *Cerdalidæ*, p. 954.

dd. Dorsal fin with soft rays only; ventral fins jugular, few rayed, sometimes very elongate.

i. Pseudobranchiæ developed; body elongate, more or less eel-shaped; ventral fins developed as slender filaments, attached at the throat not far behind eye; gill-membranes separate, free from the isthmus; body scaly. *Ophidiidæ*, p. 959.

ii. Pseudobranchiæ absent (or very rudimentary in *Brotulidæ*); body elongate or stoutish, not eel-shaped.

j. Dorsal fin single, low; ventral fins short. *Brotulidæ*, p. 965.

jj. Dorsal fins 2, the anterior fin at nape, consisting of a single slender ray. *Bregmacerotidæ*, p. 968.

aa. Eyes unsymmetrical, both on one side of head (except in very young).

k. Eyes large, well separated; preopercular margin usually distinct and not hidden by skin and scales. *Pleuronectidæ*, p. 970.

kk. Eyes small, close together; preopercular margin adnate, hidden by skin and scales. *Soleidæ*, p. 993.

AAAA. Ventral fins wholly wanting.

a. Gill-membranes broadly united to the isthmus, restricting the gill-openings to the sides; maxillaries and premaxillaries present, often immovable and united to the rest of cranium.

b. Dorsal fins 2, the anterior spine, inserted just behind cranium, the posterior of soft rays; body short and deep, much compresed; scales rough or spiny.

c. First dorsal with 3, rarely 2, spines, the first spine very large, the second locking it in erection; scales rather large, bony, forming a coat of mail. *Balistidæ*, p. 786.

cc. First dorsal with a single spine, with a rudiment at base; scales minute, bearing very slender spines, making the surface of body rough velvety. *Monacanthidæ*, p. 795.

bb. Dorsal fin continuous, of soft rays only.

d. Body enveloped in a bony box; belly not capable of inflation; teeth in the jaws separate. *Ostraciidæ*, p. 804.

dd. Body not enveloped in a bony box; belly capable of inflation; teeth in the jaws not separate, but developed into a more or less continuous plate, beak-like.

e. Teeth in each jaw anterior divided by a median suture; body not covered with large bony spines, naked or with small prickles. *Tetraodontidæ*, p. 808.

ee. The teeth in the jaws undivided, no median suture; body covered with strong bony spines. *Diodontidæ*, p. 825.

aa. Gill membranes free from the isthmus.

f. Vent at throat; vertical fins confluent; body more or less eel-shaped. *Fierasferidæ*, p. 962.

ff. Vent normally placed, not at throat; caudal fin wanting; body extremely elongate, band-shaped, tapering posteriorly; no scales. *Trichiuridæ*, p. 327.

11. PEDICULATA (the frog and bat-fishes): Carpal bones greatly elongate, forming an arm, supporting the broad pectoral; gill-openings reduced to small foramen situated near the axil more or less posterior to the pectorals; ventral fins, if present, jugular; first dorsal reduced to a few tentacle-like, mostly isolated spines; scales wanting.

a. Gill-openings in or behind the lower axil of pectoral; mouth large, terminal, nearly vertical; skin naked, smooth, or prickly. *Antennariidæ*, p. 1010.

aa. Gill-openings in or behind upper axil of pectoral; mouth small, usually inferior; skin with bony tubercles or spines. *Ogcocephalidæ*, p. 1016.

Class I. Leptocardii.

Order I. Amphioxi.

Family I. Branchiostomidæ*.

THE LANCELETS.

Body elongate, lanceolate, compressed, naked, colorless; the eye rudimentary; mouth inferior, appearing as an elongate fissure, surrounded by rather stiff cirri; dorsal fin represented by a low fold extending on the back, and usually with a rudimentary fold below representing the anal fin.

The lancelets are small translucent creatures, the largest American species reaching a length of only about 70 mm. They are quite sharply pointed at each end and largest in the middle. The lancelets are usually found embedded in sand on warm coasts throughout the world. A single genus and species is represented in the Panama collection.

1. Genus **Branchiostoma** Costa.

Branchiostoma Costa, Cenni Zoöl., Naples, 1834, 49 (type *Limax lanceolatus* Pallas).

Amphioxus Yarrell, Hist. British Fishes, 1836, 468 (type *Limax lanceolatus* Pallas).

Reproductive organs or gonads present on both sides of the median line; anal fin present, with traces of rays; vetebral column not produced backward into a caudal process. Six or seven species are recognized, some of them closely related and not well defined. One species was taken on the Pacific coast and one may be expected on the Atlantic coast of Panama. The lancelets live in warm seas, usually more or less buried in sand flats. The sexes are separate, but there is no distinction, other than that of gonads or the organs of reproduction, between the male and female. The gonads are pairs of pouches arranged along the ventral surface of the body, covered at the sides by the continuation of the body wall which, however, forms an elongate pouch on the ventral surface opening on the median

*A list of lancelets of the world by Carl L. Hubbs (Occas. Papers Mus. Zool. Univ. Mich., No. 105, 1922), containing many revisions and some new species, has recently been published. The reader is referred to this paper for the most recent grouping and classification of the lancelets.

line. When ripe the ova and sperms are liberated and fertilization takes place externally in the water.

KEY TO THE SPECIES.

a. Muscular rings, or myomeres, about 58. *caribæum*, p. 28.
aa. Muscular rings, or myomeres, about 69. *californiense*, p. 28.

1. Branchiostoma caribæum Sundevall.

Branchiostoma caribæum Sundevall, Öfvers. Vet. Akad. Förhandl., 1853, 12 (St. Thomas, Rio Janeiro); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 3.

Muscular bands or myomeres usually about 58; gonads 22 to 26 on each side; tail short; extremities attenuate. Usual length about 40 mm.

This species was not taken by us, but its range brings it within the scope of the present work.

Known from North Carolina to the mouth of the La Plata.

2. Branchiostoma californiense Gill.

Branchiostoma, species, Cooper, in Cronise, Nat. Wealth California, 1868, 489 (San Diego, Cal.).

Branchiostoma californiense Gill, in Andrews, Studies Biol. Lab. Johns Hopkins Univ., V, 1893, 238 (San Diego, Cal.); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 4.

Muscular bands or myomeres rather prominent, about 68 to 70 in number; gonads 32 to 36 on each side; the portion of body in advance of gonad bearing portion 4.6 to 5.6 in total length; gonad bearing portion 1.8 to 2; tail 3.1 to 3.55.

There are 61 specimens at hand, ranging in length from 20 to 37 mm., collected by Mr. Robert Tweedlie while operating a sand dredge. In the absence of material for comparison, we tentatively refer these specimens to *B. californiense*.

Heretofore known from the coast of California. If our identification proves to be correct, the range is now extended southward to Panama. The specimens at hand were taken at Chame Point.

Class II. Elasmobranchii.

Order II. Asterospondyli.

Family II. Orectolobidæ.

The Nurse Sharks.

Body short and subcylindrical to moderate and depressed; nostrils with a nasoral groove and with a cirrus or barbel; mouth transverse, with labial folds around angles; teeth compressed, with or without lateral cusps on each side of the median one; eyes very small, without nictitating membrane; spiracle minute to large, and behind the eye or more or less below it; gill-slits small to medium, the posterior 2 or 3 above base of pectoral; caudal fin narrow, usually without exerted lower lobe; other fins short and broad; no fin spines; no caudal pits.

2. Genus **Ginglymostoma** Müller & Henle.

Ginglymostoma Müller & Henle, Charlesw. Mag. Nat. Hist., II, 1837, 113 (type *Squalus cirratus* Gmelin).

Body moderately elongate, compressed posteriorly, depressed anteriorly; head broad; snout very blunt; nostrils near tip of snout, remote from each other, connected with the mouth by a groove, each anteriorly with a cylindrical barbel; mouth broad, little arched; teeth small, compressed, with a strong central cusp and one or more smaller lateral ones, several series functioning; spiracle minute and behind eye; gill-slits moderate, the last two close together and above base of pectoral; dorsal fins rather close together, the first over the ventrals, the second somewhat in advance of anal.

3. Ginglymostoma cirratum (Bonnaterre).

Squalus cirratus Bonnaterre, Tableau Encyclo., Ichth., 1788, 7; Gmelin Syst. Nat., I, 1789, 1492 (American Seas).

Squalus punctulatus Lacépède, Hist. Nat. Poiss., II, 1800, 120, Pl. IV, fig. 3 ("Southern America").

Squalus punctatus Bloch & Schneider, Syst. Ichth., 1801, 134 (Cuba).

Squalus argus Bancroft, Zoöl. Jour., V, 1835, 82 (West Indies).

Ginglymostoma cirratum Müller & Henle, Plagiostomen, 1841, 23; Jor-

dan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 26, Pl. IV, fig. 13; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 5 (Panama Bay); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 54, Pl. VII, figs. 4-6.

Ginglymostoma fulvum Poey, Memorias, II, 1861, 342, Pl. XIX, figs. 15 & 16 (Havana).

Ginglymostoma caboverdianus Capello, Jour. Sci. Math. Phys. Lisboa, I, 1867, 167, fig. 1 (Cape Verde).

Body posteriorly compressed, head and anterior part of body depressed; snout short, broadly rounded; mouth much in advance of eyes, making the preoral length of snout very short, mouth transverse, little arched; lips present on both jaws but not reaching the symphysis, the upper one extending to nostril and longer than the lower; teeth small, several series in function, with sharp median cusp and a smaller denticle on each side; nostrils nearly at margin of snout, connected with the mouth by a groove, anteriorly with a fleshy barbel reaching to or beyond cleft of mouth; eye very small, elongate, the longest diameter a little greater than half the longest gill-slit in the very young, proportionately much shorter in large specimens; interorbital broad, convex, .8 in snout; gill-slits 5, the last 2 very close together and above base of pectoral, the longest 2.5 to 2.85 in distance between eye and nostril; a very small spiracle back of eye; denticles on skin below base of first dorsal irregular in size, an occasional one greatly enlarged, triangular, slightly imbricate, one or three-keeled; origin of first dorsal over ventrals, about equidistant from origin of pectorals and base of caudal, the fin highest anteriorly, angles round, outer margin straight, its base .5 to .8 in distance between dorsals; second dorsal somewhat smaller, similar in shape, its base .65 to .9 in distance between dorsals; caudal long, with small notch beyond end of vertebræ, angles rounded, lower lobe not exerted; anal smaller than second dorsal, its origin under middle of base of second dorsal, its base .75 to 1.15 in distance between dorsal fins; ventral fins larger than the anal; pectoral fins nearly as broad as long, inserted nearer tip of snout than origin of ventrals.

Color of young, 337 mm. long, grayish brown, somewhat paler below than above; body and fins everywhere with distinct round black spots. A specimen 1150 mm. long is plain grayish above, somewhat paler below.

Two specimens, 337 and 1150 mm. in length, were taken. The species reaches a large size and occasionally even in the young the spots described for our specimen are wanting. Sometimes the young

have a dark band across the snout, another through the first dorsal and ventrals and a third through the second dorsal and anal.

Known from the Tropical Atlantic and Eastern Pacific. One of our specimens is from Colon and the other is from Balboa.

Family III. Galeorhinidæ.

Body elongate; head and snout depressed; tail compressed; eyes lateral, with a nictitating membrane below; nostrils on lower surface of snout; mouth inferior, crescent-shaped; teeth numerous, arranged like brick pavement, several series functioning, with or without a low cusp; spiracles present or absent; dorsal fins 2, without spine, the first above the space between the pectorals and ventrals; anal fin present.

A single genus of this family is known from the Isthmus of Panama.

3. Genus **Galeorhinus** Blainville.

Galeorhinus Blainville, Bull. Soc. Philom., 1816, 121 (type *Squalus canis* Linnæus).

Pleuracromylon Gill, Proc. Ac. Nat. Sci. Phila., 1864, 148 (type *Mustelus lævis* Müller & Henle).

Cynias Gill, Proc. U. S. Nat. Mus., 1903, 960 (type *Squalus canis* Mitchill).

Body elongate, slender; head short, broad, depressed; snout comparatively long, flattened, rounded; eyes lateral, with a well developed nictitating membrane; nostrils large, far apart, no nasoral groove; spiracles small, behind the eyes; mouth crescent-shaped, with well developed labial folds; teeth arranged like pavement, with or without low cusps; dorsals similar in shape, the first not far behind the pectorals, the second smaller and over the anal; caudal pits wanting; caudal not deep, the lower lobe scarcely exerted.

The sharks of this genus are used as food in Panama.

KEY TO THE SPECIES.

a. Dermal denticles below base of first dorsal, closely imbricate, closely adherent to the skin, without a high pedicel; no black pigment spots evident on skin between and underneath the dermal denticles.

b. Teeth with rather high and sharp apex or cusp; eye very small, its longest diameter shorter than internarial space; inner angle of nostril equidistant from tip of snout and posterior margin of upper labial fold; upper labial fold longer than the lower;

ventrals inserted notably nearer origin of anal than origin of pectorals. *dorsalis*, p. 32.

bb. Teeth rather smooth, with very low apex or cusp; eye large, its longest diameter greater than internarial space; inner angle of nostril notably nearer tip of snout than posterior margin of upper labial fold; upper labial fold a little shorter than the lower; ventrals inserted about equidistant from origin of anal and origin of pectorals. *lunulatus*, p. 33.

aa. Dermal denticles not imbricate, raised well above the surface of the skin by a long pedicel, definite, round; black pigmented spots distributed over the skin between and underneath the dermal denticles; inner angle of nostril notably nearer tip of snout than posterior margin of upper labial fold; ventrals inserted nearer origin of anal than origin of pectorals. *lævis*, p. 34.

4. Galeorhinus dorsalis (Gill).

Mustelus dorsalis Gill, Proc. Ac. Nat. Sci. Phila., 1864, 149 (Panama); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 109 (Panama).

Galeus dorsalis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 30; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 7, Pl. I, fig. 2 (Panama Bay).

Galeorhinus dorsalis Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 178.

Body slender, compressed; head strongly depressed, depth over eye 2 to 2.2 in snout; snout rather pointed, very thin, preoral length 1.8 to 2.3 in base of first dorsal, width at nostrils .95 to 1.05 in preoral length; interorbital convex, 1.1 to 1.2 in snout; nostrils transverse, with a rather long and narrow lobe, about ⅓ the width of the nostril, the inner angles equidistant from tip of snout and posterior margin of upper labial fold, internarial space 2.45 to 2.65 in preoral length of snout; eye small, elongate, its longest diameter a little less than internarial space, 2.7 to 3 in preoral length; spiracle an elongate slit; mouth rather narrow, both lips with a fold, the upper broader and longer than the lower; teeth paved, with sharp, well developed apex; dermal denticles very similar to those in *G. lunulatus*, but apparently with a sharper apex posteriorly; first dorsal moderately elevated anteriorly, its height a little shorter than base, outer margin concave, origin over or slightly in advance of inner angle of pectoral, base 1.3 to 1.6 in distance between dorsals; second dorsal similar to the first, but smaller, its base 1.55 to 2.15 in distance between dorsal fins; upper

caudal lobe rounded, 5.3 to 5.45 in total length; lower lobe scarcely exerted, 2.1 to 2.35 in the upper; anal fin notably smaller than second dorsal, with concave outer margin, its origin under middle of base of second dorsal, base .88 to 1.15 in distance between anal and base of caudal; ventral fins moderate, inserted notably nearer origin of anal than origin of pectoral; pectoral fins moderate, the posterior margin little concave, upper angle rarely reaching opposite middle of base of first dorsal.

Color plain grayish above; pale below.

The present collection contains 5 female specimens, ranging in length from 440 to 510 mm. and also 3 embryos, all males, respectively 190, 200 and 210 mm. in length, which appear to belong to this species. The teeth in the embryos are not well developed, the eyes are rather too large, the head and snout too narrow, but these differences may well be due to age.

Known from Panama Bay and Pacasmayo, Peru. Our specimens are all from the Panama City fish market.

5. Galeorhinus lunulatus (Jordan & Gilbert).

Mustelus lunulatus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 108 (Mazatlan); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 28; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 5, Pl. I, fig. 1 (Panama Bay).

Galeus lunulatus Jordan, Proc. Cal. Ac. Sci., 2nd Ser., V, 1895, 382.

Galeorhinus lunulatus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 174.

Body quite slender, compressed; head moderately depressed, depth over eye 1.6 in snout; snout rather broad and thick, preoral length 1.9 in base of first dorsal, width at nostrils .95 in preoral length; interorbital broad, flat, 1.1 in snout; nostrils transverse, with a large, broad lobe, a little less than half the width of nostril, the inner angles notably nearer tip of snout than posterior margin of upper labial fold, internarial space 2.6 in preoral length of snout; eye rather large, elongate, its longest diameter a little greater than internarial space, 2.3 in preoral length; spiracle moderate, oblong; mouth rather narrow, strongly arched, both lips with a fold, the upper notably broader and a little shorter than the lower; teeth blunt, paved, with a low blunt apex; dermal denticles on skin below base of first dorsal, ovate in form, posteriorly with sharp apex, unequal in size, closely imbricate and with 3 to 5 very low keels; first dorsal high anterior, its height equal to length of base, outer margin concave, origin slightly behind

axil of pectoral, base 1.7 in distance between dorsal fins; upper lobe of caudal rounded, 4.8 in total length; lower lobe little exerted, 2.35 in the upper; anal fin notably smaller than the second dorsal, with concave outer margin, its origin a little in advance of vertical from middle of base of second dorsal, base 1.05 in distance between anal and base of caudal; ventral fins rather broad, inserted about equidistant from origin of pectorals and origin of anal; pectoral fins large and broad, the posterior margin slightly concave, upper angle reaching nearly to end of base of first dorsal.

Color plain grayish above; pale below.

A single specimen, a female 560 mm. in length, was taken. The differences between this species and *G. dorsalis*, while not great, are numerous and have been well defined by Gilbert and Starks (1904). The present species has a deeper and less strongly compressed head and snout, a flatter interorbital, a larger eye, the nostril is nearer the tip of snout, the lobe on the narial valve is larger, the upper labial fold is slightly shorter than the lower instead of longer, the teeth are blunter, with much shorter apex or cusp, the fins are generally larger and broader, and the ventrals and first dorsal are more anteriorly inserted.

Known from the Gulf of California to Panama Bay. Our specimen is from the Panama City fish market.

6. Galeorhinus lævis (Valmont).

Squalus mustelus Linnæus, Syst. Nat., Ed. X, 1758, 235 (In part).

Galeus lævis Valmont, Dict. Hist. Nat., II, 1768, 102 (Mediterranean Sea?).

Squalus canis Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 486 (New York).

Mustelus lævis Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 127.

Squalus lævis Voigt, Tierreich, II, 1832, 508.

Mustelus equestris Bonaparte, Icon. Fauna Ital., Pesci, III, 1841, 132, Pl. LXIX, fig. 2 (Italy).

Mustelus vulgaris Müller & Henle, Plagiostomen, 1841, 64 (Europe).

Mustelus canis DeKay, Fauna N. Y., Fishes, 1842, 355, Pl. LXIV, fig. 209.

Pleuracromylon lævis Gill, Proc. Ac. Nat. Sci. Phila., 1864, 148.

Mustelus natalensis Steindachner, Sitzb. k. Ak. Wiss. Wien, LIII, 1866, 482, Pl. I.

Mustelus hinnulus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 19.

Rhinotriacis lævis Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 60.

Cynias canis Ribeiro, Arch. Mus. Nat. Brazil, XIV, 1907, 161, Pl. VII (Brazil).

Galeorhinus lævis Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 176, Pl. IV, figs. 4-9 and Pl. LX, figs. 1-4.

This species was not taken by us, but its range of distribution brings it within the scope of the present work. It is nearest to *G. lunulatus,* with which it agrees in the rather deep head, large eye, the broad nasal flap, the forward position of the nostrils, the inner angle of the opening being notably nearer tip of snout than posterior margin of upper labial fold, and in the blunt teeth. It agrees with *G. dorsalis* in having the upper labial fold longer than the lower and in the position of the fins, the origin of the dorsal being a little in advance of the lower angle of pectorals and the ventral fins being inserted notably nearer origin of anal than origin of pectorals. *G. lævis* differs from both these species in the minute spiracles and in the dermal denticles. The latter are much farther apart, not imbricate in specimens examined (400 mm.) and they have a high pedicel which raises them well above the skin. In the other species they are not raised. The denticles are also narrower and with a longer and narrower apex posteriorly. On the skin between and underneath are very definite round spots of black pigment. These pigmented spots, if present in *G. lunulatus* and *G. dorsalis,* are not visible because they are covered by the overlapping and closely adherent denticles.

Known from the coasts of Europe and the Atlantic coast of North and South America. Not as yet recorded from the Isthmus of Panama.

Family IV. Carcharhinidæ.

Body elongate; head and snout depressed; tail compressed; eyes lateral, with a more or less perfectly developed nictitating membrane; nostrils below the snout; mouth crescent-shaped, inferior; dorsal fins 2, without a spine, the first in advance of the ventrals; anal fin present.

KEY TO THE GENERA.

a. Spiracles absent.

b. Labial folds wanting; teeth more or less serrate on both margins of cusp, or only the upper teeth serrate at base.

c. Teeth more or less serrate, both on bases and cusps.
Carcharhinus, p. 36.

cc. Upper teeth serrate at base only, the lower teeth entirely smooth. *Hypoprion*, p. 50.

bb. Labial folds well developed, present on both jaws; teeth not serrate. *Scoliodon*, p. 51.

aa. Spiracles present; labial folds present; teeth in both jaws, coarsely serrate. *Galeocerdo*, p. 56.

4. Genus **Carcharhinus** Blainville.

Carcharhinus Blainville, Bull. Soc. Philom., 1816, 121 (type *Squalus commersonii* Blainville).

Carcharias Cuvier, Règne Animal, Ed. I, II, 1817, 125 (type *Squalus carcharias;* not *Carcharias* Rafinesque).

Prionodon Müller & Henle, Plagiostomen, 1841, 36 (type *Squalus glaucus* Linnæus; preoccupied).

Eulamia Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 400 (type *Carcharias lamia* Rafinesque=*Carcharhinus commersonii* Blainville).

Platypodon Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 400 (type *Carcharias menisorrah* Müller & Henle).

Isogomphodon Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 400 (type *Carcharias oxyrhynchus* Müller & Henle).

Lamiopsis Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 400 (type *Carcharias temmincki* Müller & Henle).

Body rather robust; head broad, depressed; snout produced; nostrils and mouth inferior; teeth compressed, more or less triangular, with a large cusp and usually a broad base; eyes small, with a well developed nictitating membrane; spiracles wanting; first dorsal large, placed not far behind the pectorals; second dorsal small, wholly or partly above the anal; distinct pits at base of each caudal lobe. The embryos are attached to the uterus by a placenta.

KEY TO THE SPECIES*.

a. Origin of second dorsal in advance of anal, the bases of the fins of about equal length; snout short, broad, blunt, its length

*The key offered herewith is unreliable, because of the great variations which take place with age in this group of sharks. As a rule, the head, snout and mouth are proportionately broader in the adult than in the young and the fins become more produced. A key, therefore, which shows the affinities of sharks of a certain size quite well may be entirely unsatisfactory for the same species of different sizes.

slightly greater than width of mouth; dermal denticles scarcely or not at all imbricate, three-keeled. *milberti*, p. 38.

aa. Origin of second dorsal over origin of anal, the bases of the fins of about equal length or the former a little shorter.

b. Nostrils obliquely placed, the outer angle being notably in advance of the inner, remote from each other, the interspace nearly 3 times as broad as eye.

c. Snout short, quite pointed, abruptly narrowed in advance of nostrils, preoral length 1.4 to 1.5 in base of first dorsal; mouth very broad, about 2 times as broad as long; lower teeth serrate at base only; 26 teeth in outer row in each jaw; lower half of sides with 2 broad indefinite, longitudinal, dark stripes; fins black tipped. *natator* sp. nov., p. 40.

cc. Snout rather long and acute but not abruptly narrowed in advance of nostrils, preoral length 1.2 to 1.3 in base of first dorsal; mouth narrower, always less than 2 times as broad as long; lower teeth serrate nearly to tips; 29 teeth in outer row in each jaw; fins all conspicuously black tipped. *limbatus*, p. 41.

ccc. Snout short, broadly rounded, preoral length 1.5 in base of first dorsal; mouth less than 2 times as broad as long; margins of lower teeth serrate to tips; 30 or 31 teeth in outer row in each jaw; fins with or without black tips. *commersonii*, p. 43.

bb. Nostrils transversely placed, the outer angle not in advance of the inner, rather close together, the interspace about equal to diameter of eye; snout very long, rather pointed, preoral length about .9 in base of first dorsal. *velox*, p. 45.

aaa. Origin of second dorsal behind origin of anal, the base of the former somewhat shorter than that of the latter.

d. Pectoral fins very long, reaching to or beyond end of base of first dorsal; origin of second dorsal over middle of base of anal.

e. Upper teeth broad, triangular, the lateral ones oblique, notched posteriorly at base; snout broadly rounded, not abruptly narrowed in front of nostrils; origin of first dorsal a little in advance of inner angle of pectorals; pectoral fins reaching end of base of first dorsal. *obscurus*, p. 46.

ee. Upper teeth narrow, nearly erect, not notched at base; snout abruptly narrowed in front of nostrils, yet broadly rounded at tip; origin of first dorsal over axil of pectorals; pectoral fins reaching beyond end of base of first dorsal. *remotus*, p. 47.

dd. Pectoral fins shorter, not reaching end of base of first dorsal; origin of second dorsal usually behind vertical from middle of base of anal.

f. Snout long, rather narrowly rounded; nostrils much nearer the eyes than tip of snout; 26 teeth in the outer row in each jaw. *cerdale*, p. 47.

ff. Snout moderate, broadly rounded; nostrils equidistant from eyes and tip of snout; 29 teeth in outer row in each jaw. *porosus*, p. 49.

7. Carcharhinus milberti (Müller & Henle).

Carcharias milberti Müller & Henle, Plagiostomen, 1841, 38, Pl. XIX, fig. 3, teeth (New York).

Carcharias ceruleus De Kay, Fauna N. Y., Fishes, 1842, 349, Pl. LXI, fig. 200 (New York).

Lamna caudata De Kay, Fauna N. Y., Fishes, 1842, 354, Pl. LXII, fig. 205 (Rhode Island).

Eulamia milberti Gill, Proc. Ac. Nat. Sci. Phila., 1864, 262.

Eulamia nicaraguensis Gill & Bransford, Proc. Ac. Nat. Sci. Phila., 1877, 190 (Lake Nicaragua).

Eulamia cœruleus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 245.

Carcharias fronto Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 102 (Mazatlan).

Carcharinus milberti Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 22.

Carcharias plumbeus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 872.

Carcharias azureus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 11, Pl. II, fig. 5 (Panama Bay).

Carcharinus milberti Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 133.

Snout short, broad, blunt, preoral length 1.45 in base of first dorsal, its width at nostrils .9 in preoral length; eye moderate, the diameter greater than length of nostril; interorbital area broad, convex, .85 in snout; nostrils obliquely placed, the outer angles being notably in advance of the inner ones, the inner angles about ¾ as far from mouth as from tip of snout, narial valve with an acute lobe; distance from eye to nostril 2.5 in snout; internarial space a little less than 3 times the length of diameter of eye; mouth rather broadly arched, its width at angles .95 in preoral length of snout; teeth in upper jaw triangular, with serrate edges, the anterior ones erect, the lateral

ones oblique, with broader bases and a slight notch and coarser serrations posteriorly; lower teeth narrower, more erect and with smaller serræ, a single reduced tooth in outer row at symphysis, 28 teeth in outer row in each jaw; longest gill-slit about 2 in internarial, 1.45 in distance between eye and outer angle of nostril; denticles on skin below dorsal not imbricate, three-keeled, the keels not projecting notably beyond margin of denticle; first dorsal higher than long, origin over axil of pectoral, outer margin deeply concave, the posterior lobe not greatly produced, base 2.1 in distance between dorsal fins; second dorsal small, origin of fin a little in advance of anal, outer margin scarcely concave, base 5.2 in distance between dorsals; upper lobe of caudal moderate, pointed, 4.15 in total length; lower lobe broad, blunter, 2.45 in upper lobe; anal fin about equal to second dorsal, its outer margin deeply concave, 1.5 in distance from anal to base of lower lobe of caudal; ventral fins rather small, inserted about midway between origin of anal and vertical from end of base of first dorsal; pectoral fins moderate, reaching opposite end of base of first dorsal, posterior margin concave, the lower lobe about 3 in upper.

Color grayish above; pale yellowish below and dusted with gray; fins without black tips, but all except the dorsals with pale margins.

This species was not taken by us on either coast of Panama. The above description is based on a specimen, a partial skin, 620 mm. long, from the U. S. National Museum collection, taken at Beesley's Point, N. J. We follow Garman in regarding *C. azureus* from the Pacific identical with *C. milberti* from the Atlantic, but a specimen, a partial skin, of *C. azureus* from Ecuador identified and compared with the type by Starks (Proc. U. S. Nat. Mus., 1906, p. 763) and found to agree in all essential characters was compared by us with the specimen described in the foregoing description and found to differ in several respects. The Pacific specimen is 1025 mm. long, hence much larger than the Atlantic specimen, and the differences noticed may be due to age. The body appears to be more robust in the Pacific specimen, the head broader and more strongly depressed, the snout is broader and much more bluntly rounded, preoral length 1.9 in base of first dorsal, mouth at angles .6 in preoral length, width of snout at nostrils .7 in preoral length. The teeth are rather broader and more coarsely serrate, the dermal denticles on skin below base of first dorsal are three-keeled as in the Atlantic specimen, but the keels are higher and extend prominently beyond the margin of the denticle like sharply pointed spines. The fins appear to be higher, the lower lobe of the pectoral less prominent, being contained in the upper 4 times, the

upper caudal lobe 3.4 in the total length, the lower lobe 1.9 in the upper, the base of the anal is contained 1.1 times in distance between base of anal and base of lower lobe of caudal. We certainly must regard the present arrangement as tentative only, for more specimens must be compared before the true affinities of the specimens from the opposite coasts can be established.

Known, as understood by Garman, from the Middle Atlantic and Middle Eastern Pacific. Recorded from Panama Bay by Gilbert and Starks.

8. Carcharhinus natator sp. nov. (Plate I, fig. 1.)

Type No. 79310, U. S. N. M.; length 850 mm.; Panama City.

Body compressed; head depressed; snout rather short, acute, decreasing rapidly in width in advance of nostrils, preoral length 1.4 to 1.5 in base of first dorsal, its width at nostrils 1.1 in preoral length; eye small, its diameter only slightly longer than nostril; interorbital area convex, .9 in snout; nostrils obliquely placed, the outer angles being in advance of the inner ones, the inner angles about ¾ as far from mouth as from tip of snout, narial valve with a very small, acute lobe; distance from eye to nostril 2.75 to 2.8 in snout; internarial space 3.75 times diameter of eye; mouth broadly arched, nearly twice as wide as long, its width at angles .9 in preoral length of snout; teeth rather narrow, the upper ones broader than the lower, all the teeth with broad bases, the lower teeth erect, serrate only at base, the upper ones serrate nearly to tips and the lateral teeth posteriorly with a slight notch followed by coarser serrations, each jaw with about 26 teeth in outer row; gill-slits rather long, the longest about 1.25 in internarial, .65 in distance between eye and outer angle of nostril; denticles on skin below base of first dorsal three or five-keeled; first dorsal moderate, its height greater than its base, its origin a little in advance of tips of lower lobe of pectorals, its outer margin rather deeply concave, the base 1.85 in distance between the dorsal fins; second dorsal moderate, its origin over that of the anal, a little more than half as far from anterior margin of caudal pit as from base of first dorsal, outer margin of fin slightly concave, the posterior lobe acuminate, reaching half way to caudal pit, base of fin 4.4 to 4.8 in distance between dorsals; upper lobe of caudal long, quite narrow, 3.5 in total length; lower lobe broader and less sharply pointed, 1.2 in upper lobe; anal fin about equal in length to second dorsal, its outer margin deeply concave, posterior lobe pointed, reaching ¾ the distance to caudal pit, its base 1.15 to 1.2 in distance from base of anal to base

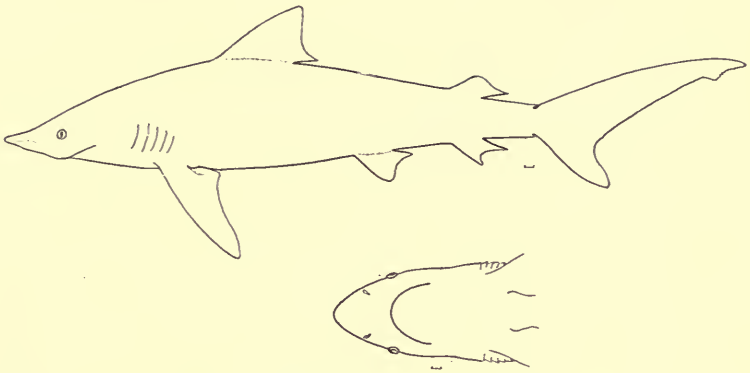

FIG. 1. CARCHARHINUS NATATOR sp. nov.
a. Ventral surface of head.
Drawn from type U. S. N. M. No. 79310.

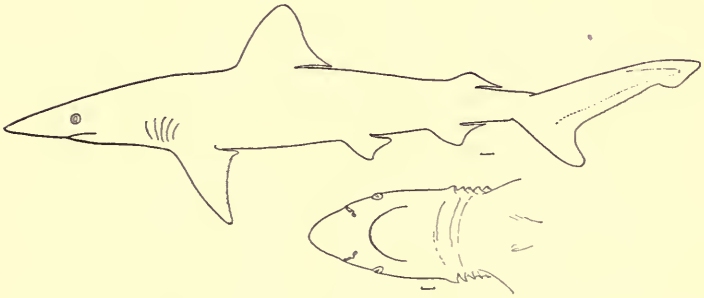

FIG. 2. CARCHARHINUS CERDALE Gilbert.
a. Ventral surface of head.
Drawn from U. S. N. M. No. 79312.

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of lower lobe of caudal; ventral fins rather small, inserted about equidistant from origin of anal and vertical from the beginning of second third of base of first dorsal; pectoral fins long, falcate, reaching opposite the end of the base of the first dorsal, about an eye's diameter shorter than head to first gill-slit, the inner lobe, 3.6 to 3.75 in the length of the outer lobe.

Color dark grayish above; pale below. Lower half of sides with 2 rather broad, ill-defined longitudinal dark stripes, the upper one extending on caudal peduncle, the lower one ending over base of anal. Lower surface of head and snout more or less dusky. The fins all with black tips, most conspicuous on pectorals and lower lobe of caudal.

Only 2 specimens, both females, 825 and 850 mm. in length, were secured. This species is probably rather close to *C. menisorrah* (Müller & Henle), known from the Red Sea and the Malay Archipelago. The shape of the snout and the position of the second dorsal and anal appear to be identical, but the mouth in the present species is broader, the first dorsal is inserted farther backward, the outer lobes of the pectorals as compared with the inner lobes are much longer, the lower teeth are serrate at base instead of being entirely smooth, and the color is different. The species may be distinguished from all other American sharks of this genus by the short and abruptly pointed snout and broad mouth.

Our specimens were purchased in the Panama City fish market.

9. Carcharhinus limbatus (Müller & Henle).

Carcharias limbatus Müller & Henle, Plagiostomen, 1841, 49, Pl. XIX, fig. 9 (Martinique).

Carcharias microps Lowe, Proc. Zoöl. Soc. London, 1840, 38.

Prionodon cucuri Castelnau, Anim. Nov. Rares Amér. Sud, 1855, 99 (Bahia).

Isogomphodon maculipinnis Poey, Repertorio, I, 1867, 191 (Cuba).

Carcharias mülleri Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXI) Ichth. Notizen, VI, 1867, 50 (West Indies).

Carcharias ehrenbergi Klunzinger, Syn. Fische, II, 1871, 221.

Carcharias æthalorus Jordan & Gilbert, Proc. U .S. Nat. Mus., 1882, 104 (Mazatlan); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 9 (Panama Bay).

Carcharhinus limbatus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 40.

Carcharinus limbatus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 127.

Body compressed; head depressed; snout long, rather acute, preoral length 1.2 to 1.3 in base of first dorsal, its width at nostrils 1.15 to 1.2 in preoral length; eye small, its diameter only slightly longer than nostril; interorbital area convex, .85 to .95 in snout; nostrils obliquely placed, the outer angles being in advance of the inner ones, the inner angles about ¾ as far from mouth as from tip of snout; narial valve with a very small, acute lobe; distance from eye to nostril 2.8 to 3 in snout; internarial space a little less than 3 times as long as eye; mouth rather broadly arched, its width .95 to 1.1 in preoral part of snout; teeth narrow, all finely serrate, the upper ones somewhat broader than the lower ones, with broad bases, a very slight notch at base on posterior margin of upper teeth, followed by serrations considerably coarser than those on the cusp, the lower teeth erect, the lateral teeth in upper jaw moderately oblique, each jaw with 29 teeth in outer row; gill-slits moderate, the longest somewhat shorter than the internarial, .65 to .75 in distance between eye and outer angle of nostril; denticals on skin below base of first dorsal three to five-keeled; first dorsal moderate, its height longer than base, its origin over or a little in advance of tips of lower lobe of pectorals, its outer margin concave, the base 1.8 to 2.1 in distance between the dorsal fins; second dorsal moderate, its origin over that of the anal, about half as far from anterior margin of caudal pit as from base of first dorsal, outer margin of fin scarcely concave, the posterior lobe moderately produced, reaching a little more than half way to caudal pit, base of fin 4 to 5 in distance between dorsals; upper lobe of caudal long, 3.5 to 3.6 in total length, lower lobe rather acuminate, 2.1 to 2.35 in the upper; anal fin equal in length to second dorsal, with deeply concave margin, the posterior lobe pointed, reaching about ⅔ the distance to caudal pit, its base 1.25 to 1.45 in distance from base of anal to base of lower lobe of caudal; ventral fins moderate, the claspers shorter than the fins in a specimen 925 mm. in length and not much better developed than in an embryo 335 mm. long, the fins inserted equidistant from origin of anal and vertical from the beginning of the second third of base of first dorsal; pectoral fins large, falcate, reaching nearly or quite opposite the end of base of first dorsal, at least an eye's diameter longer than distance from posterior angle of mouth to tip of snout, proportionately longer in the adult than in young, the inner lobe 3.25 to 3.75 in length of the outer.

Color grayish above; pale yellow. The fins all with dark or black tips, the black more pronounced in the adult than in the young.

Three specimens, respectively 335, 490 and 925 mm. in length, were preserved. They are all from the Pacific and they agree well with *C. æthalorus* of which we have had the type for comparison. We have not seen any specimens of *C. limbatus* from the Atlantic but we follow Garman in considering *C. æthalorus* and *C. limbatus* identical. The species is occasionally seen in the Panama City fish market and it is of small commercial value. It probably reaches a much larger size than *C. cerdale,* for the embryo at hand, which is well developed but on which the umbilical attachment is still plainly visible, is about 25 mm. longer than embryos of similar development of *C. cerdale,* and a male of 925 mm. long has the claspers poorly developed, being shorter than the ventral fins, while a specimen of *C. cerdale* 825 mm. in length has the claspers well developed, being nearly twice the length of the fins.

Recorded on the Atlantic from Massachusetts to Brazil, on the Pacific from Mazatlan to Panama and as understood by Garman it also occurs in the Red Sea. Two of our specimens were purchased in the Panama City market and an embryo was sent from Chame Point by Robert Tweedlie.

10. Carcharhinus commersonii Blainville.

Carcharhinus commersonii Blainville, Bull. Sci. Philom., 1816, 121 (Sicily).

Carcharias lamia Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 119 (Nice).

Carcharias leucas Müller & Henle, Plagiostomen, 1841, 42 (West Indies).

Squalus longimanus Poey, Memorias, II, 1861, 338, Pl. XIX, figs. 9 & 10, teeth (Cuba).

Prionodon lamia Bocage & Capello, Plagiostomen, 1866, 18.

Eulamia longimana Poey, Repertorio, III, 1868, 448.

Eulamia lamia Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 32.

Carcharias lamiella Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 110 (San Diego, Cal.).

Eulamia lamiella Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 179.

Eulamia platyrhynchus Gilbert, Proc. U. S. Nat. Mus., 1891, 543 (Magdalena Bay).

Carcharhinus platyrhynchus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 36.

Carcharhinus lamiella Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 37.

Carcharhinus lamia Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 38, Pl. V, fig. 17.

Carcharias insularum Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 513, Pl. I, fig. 1 (Hawaiian Islands).

Carcharias nesiotes Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 514, Pl. I, fig. 2 (Hawaiian Islands).

Carcharinus commersonii Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 140.

Snout short, broadly rounded, preoral length 1.5 in base of first dorsal, its width at nostrils 1 in preoral length; eye small, its diameter slightly longer than nostril; interorbital broad, .78 in snout; nostrils obliquely placed, the outer angles being in advance of the inner ones, the inner angles about ¾ as far from mouth as from tip of snout, narial valve with a very short, scarcely acute lobe; distance from eye to nostril 2.45 in snout; internarial space 4.5 times diameter of eye; mouth very broadly arched, about 1.5 times as broad as long, its width at angles .7 in preoral length of snout; teeth in upper jaw triangular, with broad bases, distinctly serrate, the serrations on base much larger than those on the cusp, the lateral teeth not notched posteriorly, and not very strongly oblique; lower teeth somewhat narrower, more erect and less strongly serrate, 2 greatly reduced teeth in outer row at symphysis; each jaw with 30 or 31 teeth in outer row; gill-slits moderate, the longest 1.5 in internarial; denticles on skin below base of first dorsal five-keeled, scalloped and rather closely imbricate; first dorsal moderate, its height greater than the length of its base, its origin over tips of lower lobe of pectorals, its outer margin concave, the lower lobe acuminate, the base 2.25 in distance between dorsal fins; second dorsal moderate, its origin over that of the anal, outer margin of fin definitely concave, the posterior lobe notably produced, reaching about ⅔ the distance to caudal pit, base of fin 5.4 in distance between dorsals; upper lobe of caudal very long, pointed, 3.75 in total length; lower lobe prominent, also pointed, 2.05 in the upper; anal about equal in length to second dorsal, its base 1.7 in distance to base of lower lobe of caudal, anteriorly notably higher than the second dorsal, its outer margin deeply concave; ventral fins small, the claspers more than twice the length of the part of fins adjacent; pectoral fins long, falcate, reaching a little beyond base of first dorsal, about equal to head to first gill-slit, its width 1.8 in its length, the length of the inner lobe about 4 in length of the outer lobe.

Color dark grayish above; lower parts pale and irregularly blotched with dusky. The median part of tail behind second dorsal nearly black. The tips of the pectorals, second dorsal, lower lobe of the caudal and ventrals with distinct black tips.

We have 2 specimens, skins, 1450 and 1500 mm. in length, which we refer to this species. The measurements given in the above description are only approximate as they are based upon the skins. The teeth and dermal denticles agree quite well with descriptions at hand, but the pectoral fins appear to be proportionately longer and the color agrees with *C. limbatus* instead of *C. commersonii.* Garman, whom we follow in giving the synonymy of the species, evidently allows for much variation in color and structure, hence the present specimens are probably within those variations, although they are not mentioned in his description.

Known, as understood by Garman, from the Mediterranean Sea and the Middle Atlantic and the Pacific. Our specimens were taken with hook and line at Colon.

11. Carcharhinus velox Gilbert.

Carcharhinus velox Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2747 (Panama Bay).

Carcharias velox Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 9, Pl. I, fig. 3 (Panama Bay).

Carcharinus velox Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 130.

Body slender; head narrow; snout long, rather pointed, preoral portion .85 to .9 in base of first dorsal, its width at nostrils 1.6 to 1.8 in preoral length; eye small, its diameter slightly greater than width of nostril; interorbital area convex, 1.4 in snout; nostrils transversely placed, rather close together, inner angles closer to mouth than to tip of snout by a distance nearly equal to half the nostril, narial valve with a broad lobe, never pointed; distance from nostril to eye 2.2 in snout; internarial space equal to diameter of eye; mouth much arched, its width 1.45 to 1.65 in preoral part of snout; teeth very narrow, especially those in lower jaw, broad at base, serrations on sides fine, noticeable only under a lens, the lateral teeth in upper jaw with a notch at base posteriorly; gill-slits rather narrow, the longest slightly longer than internarial space, 1.55 to 1.8 in space betweeen eye and outer angle of nostril; first dorsal rather large, its height exceeding the length of base, its origin about an eye's diameter behind vertical from axil to pectorals, its outer margin rather deeply concave,

base 2.05 to 2.26 in distance between the dorsal fins; second dorsal small, opposite anal and 2 times as far from the base of the first dorsal as from caudal pit, its outer margin nearly straight, its base 4.7 to 5.7 in distance between dorsals; upper lobe of caudal much produced, 3.1 in total length measured from caudal pit, the lower lobe exerted, 2.6 in upper lobe; anal fin a little larger than second dorsal, its outer margin deeply concave, its base 1.4 to 1.6 in distance between base of anal and base of lower caudal lobe; ventral fins moderate, the claspers shorter than fins (specimen 500 mm.), inserted a little nearer origin of anal than vertical from origin of dorsal; pectoral fins broadly falcate, their posterior margin concave, both angles rounded, tips reaching slightly past base of first dorsal, the longest part of fin equal to snout in advance of posterior angle of mouth.

Color bluish above; grayish white below.

The above description is based on 2 specimens, a male and female respectively 560 and 570 mm. in length, purchased in the Panama City market. This species heretofore was known only from the type, a female, 1200 mm. long.

Known only from Panama Bay.

12. Carcharhinus obscurus (Le Sueur).

Squalus obscurus Le Sueur, Journ. Ac. Nat. Sci. Phila., I, 1818, 223, Pl. IX (New York).

Carcharias falcipinnis Lowe, Proc. Zoöl. Soc.London,1839, 90(Madeira).

Carcharias obscurus Müller & Henle, Plagiostomen, 1841, 46.

Prionodon obvelatus Valenciennes, in Webb & Berthelot, Hist. Nat. Iles Canaries, II, Pt. II, 1843, 103, Pl. XXVI (Canary Islands).

Platypodon obscurus Gill, Proc. Ac. Nat. Sci. Phila., 1864, 262.

Carcharhinus obscurus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 35.

Carcharinus obscurus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 22; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 130.

This shark was not seen by us and it is not recorded from the Isthmus but its range of distribution brings it within the scope of the present work. It is characterized as having a broadly rounded snout; mouth large, its width greater than preoral length, its length 1.65 in its width; teeth serrate, the upper ones broad, oblique, with a notch on posterior edge, the lower teeth narrower, with broad bases; origin of first dorsal a little in advance of inner angle of pectorals, the base equal to width of mouth, more than ⅓ the distance between dorsal fins; second dorsal smaller than the anal, about ⅓ as long as first

dorsal, its origin over middle of base of anal; upper caudal lobe more than ¼ the total length, angle pointed; lower lobe prominent; anal fin with deeply concave outer margin; pectoral fins long, falcate, pointed, nearly twice as long as broad, reaching end of base of first dorsal. Color grayish brown above; whitish below.

Known from the Northern and Middle Atlantic.

13. Carcharhinus remotus (Valenciennes).

Carcharias remotus Valenciennes, in Dumeril, Hist. Nat. Poiss., I, 1865, 374 (Martinique).

Platypodon perezii Poey, Enumeratio, 1875, 195 (Cuba).

Carcharhinus perezi Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 36.

Carcharhinus remotus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 37.

Carcharinus remotus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 138.

This shark was not seen by us and it is not recorded from the Isthmus but its range of distribution brings it within the scope of the present work. It is characterized as having a depressed head, an abruptly narrowed snout in advance of nostrils but broadly rounded in front, about 1.5 times length of mouth; mouth large, its width equal to length of snout; teeth narrow, erect, with broad bases and serrate edges; gill-slits less than twice diameter of eye; first dorsal about as high as long, the origin over axil of pectorals, equidistant from tip of snout and origin of second dorsal, its base 2.5 in distance between dorsal fins; second dorsal smaller than the anal, its origin over middle of base of anal, the base of fin about 6 in distance between dorsal fins; upper lobe of caudal long, about 3.5 in total length; anal fin with deeply concave outer margin, its base about 5 in distance between dorsal fins; pectoral fins falcate, the outer lobe produced, reaching past end of base of first dorsal, the inner lobe short, rounded. Color brownish above; whitish below. Fins with dark edgings, except the posterior margin of pectorals which are white.

Known from the West Indies to Brazil.

14. Carcharhinus cerdale Gilbert. (Plate I, fig. 2.)

Carcharhinus cerdale Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2746 (Panama Bay).

Carcharias cerdale Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 10, Pl. II, fig. 4 (Panama Bay).

Carcharinus menisorrah Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 135 (In part; not of Müller & Henle).

Body moderate; head rather narrow, depressed; snout rather long, moderately rounded, preoral portion 1.05 to 1.6 in base of first dorsal, its width at nostrils .96 to 1.13 in preoral length; eye small, its diameter slightly greater than width of nostril; interorbital area convex, .89 to 1.05 in snout; nostrils obliquely placed, the outer angles being in advance of the inner ones, the inner angles about ⅔ as far from mouth as from tip of snout, narial valve with a sharply pointed lobe; distance from eye to nostril 2.82 to 3.4 in snout; internarial space nearly 3 times as long as eye; mouth arched, its width .9 to 1.44 in preoral part of snout (The head and mouth become proportionately broader with age and the snout becomes shorter which accounts for the great variation shown in some of the measurements about the head); teeth serrate, those in upper jaw broader and more oblique than the lower ones, and with broader bases, a rather prominent notch behind the large triangular cusp of the lateral teeth in upper jaw followed by 1 or 2 small denticles, each jaw with 26 teeth in outer row; gill-slits rather narrow, always notably shorter than internarial, .88 to 1.2 in distance between eye and outer angle of nostril; denticles on skin below base of first dorsal three-keeled; first dorsal moderate, its height somewhat greater than the length of its base, its origin over or a little in advance of the tip of lower angle of pectorals, its outer margin concave, the base 2 to 2.6 in distance between the dorsal fins; second dorasl small, its origin over or a little behind vertical from middle of base of anal, not quite half as far from caudal pit as from base of first dorsal, its outer margin scarcely concave, the posterior lobe produced, reaching nearly or quite half the distance to caudal pit, its base 5.8 to 9.7 in distance between dorsals; upper lobe of caudal very long, 3.9 to 4.4 in total length; the lower lobe broad, 2.1 to 2.4 in the length of the upper; anal fin somewhat larger than the second dorsal, its outer margin rather deeply concave, the posterior lobe acuminate, reaching fully half way to caudal pit, its base 1.55 to 1.95 in distance between base of anal and base of lower lobe of caudal; ventral fins moderate, the claspers in male shorter than the fins in specimens 500 mm. in length, about 2 times the length of fins in specimens 825 mm. long, the fins inserted a little nearer origin of anal than vertical from origin of dorsal; pectoral fins rather large, falcate, usually reaching past middle but not beyond entire base of first dorsal, the outer lobe about as long as distance from posterior angle of mouth to tip of snout in young, proportionately much longer in adult.

Color bluish gray above; pale below.

We have at hand 19 specimens, ranging in length from 310 to 825 mm., from the Pacific coast of Panama which undoubtedly are identical with *C. cerdale* of Gilbert, as we have had for comparison specimens from Panama Bay identified by Gilbert, probably paratypes. This species was referred to *C. menisorrah* by Garman, but our specimens do not agree in several particulars with Garman's description of *C. menisorrah* and especially not in the size and position of the second dorsal fin with respect to that of the anal. These fins are never of the same size in *C. cerdale* and the origin of the second dorsal is not over that of the anal but always notably behind it. We, therefore, regard *C. cerdale* as separate and distinct. We also have at hand 13 specimens, ranging from 385 to 550 mm. in length, from the Atlantic coast which we are unable to identify with any known species from the Atlantic. Careful comparison of specimens, as well as a large series of measurements based on every specimen at hand, have revealed no differences between the representatives from the opposite coasts. We, therefore, also refer these Atlantic spcimens to *C. cerdale*. We have several specimens from Chame Point sent by Mr. Robert Tweedlie which are embryos taken from the mother but which are well developed, with umbilical cord attached, being from 310 to 330 mm. in length. No information relative to the size of the mother shark was supplied, but the species probably does not reach a large size, as a male, 825 mm. in length, has the claspers so well developed that it undoubtedly is sexually mature. This shark appears to be abundant on both coasts of Panama and it occurs in the fish markets almost daily, being utilized as food by the natives.

Recorded only from Panama Bay and Guayaquil, Ecuador. Our specimens from the Pacific are from Chame Point and the Panama City fish market, and those from the Atlantic are from the Colon fish market.

15. Carcharhinus porosus (Ranzani).

Carcharias porosus Ranzani, Novi. Comment. Ac. Sci. Inst. Bonon., IV, 1840, 70 (Brazil).

Carcharias henlei Valenciennes, in Müller & Henle, Plagiostomen, 1841, 46, Pl. XIX, fig. 6, teeth (Guiana).

Carcharhinus henlei Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 37.

Carcharinus porosus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 131.

This species was not seen by us and is not recorded from the Isthmus, but its distribution brings it within the scope of the present work. It is characterized as having a broadly rounded snout; the nostrils as far from eye as from tip of snout, narial valve with an acute lobe; mouth moderate, nearly half as long as snout and more than half as broad; teeth serrate, the upper broadly triangular, the lateral ones posteriorly with a sharp notch at base of cusp, the lower teeth narrower, each jaw with 29 teeth in the outer row; origin of dorsal little in advance of the lower angle of pectoral, outer margin concave; second dorsal much smaller than the anal, its origin over the posterior fourth of base of anal; upper lobe of caudal about 4 in total length, with blunt angle; anal fin with deeply concave margin; ventrals small, inserted nearer the first than second dorsal; pectoral fins broad, not reaching end of base of first dorsal, the lower margin ⅔ of the upper. Color brownish above; white below; edges of caudal dark; the lower fins with pale margins.

Known from the West Indies to Brazil.

5. Genus **Hypoprion** Müller & Henle.

Hypoprion Müller & Henle, Plagiostomen, 1838, 34 (type *Carcharias malcoti* Müller & Henle).

Hypoprionodon Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 400 (type *Carcharias hemiodon* Valenciennes).

This genus differs from *Carcharhinus* only in the smoother teeth, the lower ones being entirely smooth and the upper ones serrate at base only.

16. **Hypoprion brevirostris** Poey.

Hypoprion brevirostris Poey, Repertorio, II, 1868, 451, Pl. IV, figs. 5, 6 and 20 (Cuba); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 41, Pl. V, fig. 18; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 120.

Snout short, broadly rounded, preoral length 1.95 to 2.1 in base of first dorsal, its width at nostrils .65 in preoral length; interorbital broad, .7 in snout; nostrils obliquely placed, the inner angles nearer mouth than tip of snout, the valve with a large, acute lobe; nostrils remote from each other, internarial space about 3.5 times diameter of eye; mouth broad, its width at angles about .65 in preoral length of snout; teeth rather narrow, with broad bases, only the base of the upper ones serrate, the lower teeth erect, the lateral teeth in upper

jaw oblique, each jaw with 28 to 30 teeth in the outer row, the median teeth at symphysis greatly reduced; denticles on skin below first dorsal irregular in size, the small ones three-keeled, the large ones five-keeled, more closely imbricate in the adult than in the young, posterior margin of the denticles deeply scalloped; first dorsal rather small, outer margin concave, the lower angle prominent, inserted somewhat nearer tip of snout than caudal pit, base 1.8 to 2.05 in distance between dorsal fins; second dorsal large, not very much smaller than the first dorsal, its outer margin convex, the posterior lobe acute, reaching about half-way to caudal pit, base of fin 2.1 to 2.3 in distance between the dorsal fins; upper lobe of caudal moderate, point rounded, 4 to 4.26 in total length; lower lobe acute 1.95 to 2.1 in the upper; anal fin smaller than second dorsal, outer margin deeply concave, posterior angle acute, reaching scarcely half-way to caudal pit, origin of fin under or slightly in advance of second dorsal, base about equal to its distance from base of lower lobe of caudal; ventral fins moderate, inserted somewhat nearer origin of anal than vertical from end of base of first dorsal; pectoral fins not very long but broad, the width about ¾ of outer margin, posterior margin broadly concave, the fin reaching a little beyond front of first dorsal.

Color grayish dusky above; lower parts pale yellowish, dusted with gray. The fins somewhat darkened at tips.

This species is represented by 2 skins, about 1075 and 1300 mm. in length. The measurements given in the above description are based on these skins and therefore they are only approximate. The species is probably not uncommon on the Atlantic coast of Panama.

Recorded from the West Indies north to North Carolina, and from Para, Brazil. Our specimens are from Toro Point and Porto Bello.

6. Genus **Scoliodon** Müller & Henle.

Scoliodon Müller & Henle, Charlesw. Mag. Nat. Hist., II, 1837, 114 (type *Carcharias laticaudus* Müller & Henle).

This genus differs from *Carcharhinus* in the presence of labial folds, which extend some distance along the jaws from the angles of the mouth, and the teeth are never serrate.

KEY TO THE SPECIES.

a. Head and snout very narrow, sharply pointed; width of snout at nostrils 1.3 to 1.4 in preoral length; interorbital 1.2 to 1.25 in snout in specimens about 530 mm. in length; upper labial

fold as long as eye, slightly greater than ⅓ the length of jaw; inner angle of nostril about ½ as far from the mouth as from tip of snout; upper lobe of caudal rather short, 4.2 to 4.35 in total length. *longurio,* p. 52.

aa. Head and snout somewhat broader; snout less sharply pointed, its width at nostrils 1.1 to 1.15 in preoral length; interorbital 1.05 to 1.1 in snout in specimens about 530 mm. in length; labial folds shorter, the upper one about ⅘ the length of eye, scarcely ⅓ the length of jaw; inner angle of nostril about ½ as far from mouth as from tip of snout; upper lobe of caudal very long, 3.85 to 4 in total length. *lalandii,* p. 53.

aaa. Head and snout broad; snout broadly rounded, its width at nostrils 1.05 in preoral length; interorbital 1.05 to 1.15 in snout; labial folds very short, the upper one about ⅔ the length of eye, notably less than ⅓ the length of jaw; inner angle of nostril about ⅔ as far from mouth as from tip of snout; upper lobe of caudal very long, 3.85 in total length. *terræ-novæ,* p. 55.

17. Scoliodon longurio (Jordan & Gilbert). (Plate II, fig. 1.)

Carcharias longurio Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 106 (Mazatlan).

Scoliodon longurio Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 42; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 12 (Panama Bay).

Body slender, head narrow; snout quite long and pointed, preoral portion 1.05 to 1.13 in length in advance of eye, its width at nostrils 1.15 to 1.4 in preoral length, and 1.3 to 1.5 in length to eye; eye rather small, its diameter greater than width of nostril; interorbital area convex, 1.05 to 1.25 in snout; nostrils obliquely placed, the outer angles being considerably in advance of the inner ones, the inner angles about half as far from the mouth as from tip of snout, narial valve with a sharply pointed lobe; distance from nostril to eye 3.2 to 3.3 in snout; internarial space about 2.5 times the diameter of eye; mouth strongly arched, apparently proportionately broader in the adult than in the young, its width at angles 1.05 to 1.35 in preoral part of snout; labial folds prominent on both lips, the upper one fully ⅓ the length of jaw, as long as eye, 3.2 to 4.3 in preoral part of snout, and 2 to 2.3 in internarial space, the one on lower lip shorter, 4.8 to 5.7 in preoral part of snout; teeth not serrate, with broad bases and rather narrow cusps, the anterior ones quite erect, those at sides directed inward and back-

FIG. 1. SCOLIODON LONGURIO (Jordan & Gilbert).
a. Ventral surface of head.
Drawn from U. S. N. M. No. 79291.

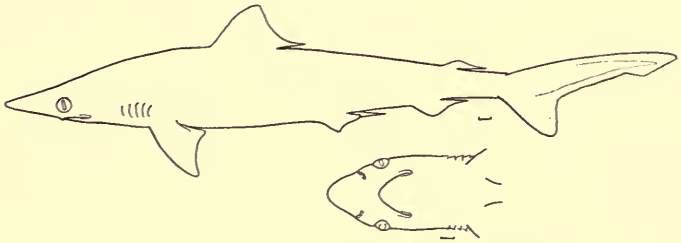

FIG. 2. SCOLIODON LALANDII (Müller & Henle).
a. Ventral surface of head.
Drawn from U. S. N. M. No. 79290.

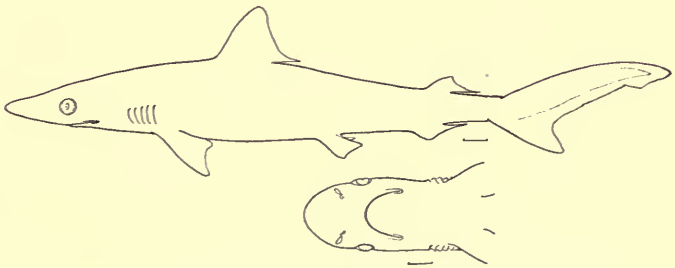

FIG. 3. SCOLIODON TERRÆ-NOVÆ Richardson.
a. Ventral surface of head.
Drawn from U. S. N. M. No. 79324.

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ward, those of upper jaw broader and more oblique and with a rather prominent notch behind at base of cusp; gill-slits rather narrow, the longest one about 2 times in internarial space, 1 to 1.33 in space between eye and outer angle of nostril; first dorsal rather large, its outer margin concave, the lower lobe long and pointed, its origin about 2 times diameter of eye behind vertical from axil of pectoral, base 2.5 to 2.65 in distance between dorsals; second dorsal very small, its outer margin concave, the posterior lobe much produced, pointed, nearly 2 times the base of fin, origin of fin a little behind middle of base of anal, base 8.4 to 9.8 in distance between dorsals; upper lobe of caudal rather short, pointed, 4.2 to 4.35 in total length, the lower lobe rather bluntly pointed, 2.25 to 2.6 in upper lobe; anal fin with concave margin, its base 1.75 to 2.15 in distance from anal to base of lower lobe of caudal; ventral fins rather small, inserted about equidistant from axil of pectoral and posterior margin of base of anal, the claspers in specimen 525 mm. in length shorter than the fins, in a specimen 700 mm. long the claspers are nearly 3 times the length of the fins; pectoral fins moderate, posterior margin concave, reaching somewhat beyond middle of base of dorsal in our large specimen, notably shorter in young.

Color bluish gray above; pale below.

Two male specimens were obtained, respectively 525 and 700 mm. in length. We have had for comparison 2 type specimens from Mazatlan. Our large male, although smaller than the male of the "types", has the claspers much more prominently developed and more strongly ossified. In other respects our specimens agree with the types. The species is used as food to a limited extent in Panama.

Known from Mazatlan to Panama. Our specimens are from the Panama City fish market.

18. Scoliodon lalandii (Müller & Henle). (Plate II, fig. 2.)

Carcharias lalandii Müller & Henle, Plagiostomen, 1838, 30 (Brazil).

Scoliodon lalandii Castelnau, Anim. Nouv. Rares Amér. Sud. 1855, 100 (Brazil); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 113.

Body slender, head rather narrow; snout moderately long and pointed, preoral portion 1.1 in length of eye, its width at nostrils 1.1 to 1.15 in preoral length, and 1.25 to 1.3 in length to eye; eye rather small, its diameter greater than width of nostril; interorbital area convex, 1.05 to 1.1 in snout; nostrils obliquely placed, the outer angles being considerably in advance of the inner ones, the inner angles about half

as far from the mouth as from tip of snout, narial valve with a sharply pointed lobe; distance from nostril to eye 3 to 3.3 in snout; internarial space slightly greater than 2 times diameter of eye; mouth rather strongly arched, its width at angles 1.15 to 1.4 in preoral part of snout; labial folds rather prominent on both lips, the upper one a little less than ⅓ the length of jaw, about ⅘ the length of eye, 4.1 to 4.5 in preoral part of snout and 2.55 to 2.75 in internarial space, the lower fold shorter, 4.8 to 5.8 in preoral part of snout; teeth as in *S. longurio;* gill-slits rather narrow, the longest about 2 times in internarial, 1.05 to 1.4 in distance from eye to outer angle of nostril; first dorsal rather large, its shape and position as in *S. longurio,* its base 2.5 to 2.6 in distance between dorsal fins; second dorsal very small, its outer margin scarcely concave, posteriorly much produced, pointed, origin of fin a little behind middle of base of anal, base 9.4 to 13.1 in distance between dorsal fins; upper lobe of caudal very long, pointed, 3.85 to 4 in total length, the lower lobe rather bluntly pointed, 2.6 to 2.75 in upper lobe; anal fin with concave margin, its base 1.8 to 2.05 in distance from anal to base of caudal; ventral fins rather small, inserted equidistant from axil of pectoral and posterior margin of base of anal, the claspers in specimens 510 to 530 mm. in length at least twice as long as the fins; pectoral fins moderate, the posterior margin concave, not quite reaching opposite middle of base of first dorsal.

Color bluish gray above; pale below.

This fish is represented in the present collection by 4 male specimens, ranging in length from 110 to 130 mm. The species is extremely closely related to *S. longurio* from which it is separated with difficulty. *S. lalandii* has a broader head, wider interorbital and a less narrowly pointed snout. The head and snout, however, are proportionately broader in adult than in the young, and, therefore, these differences are evident only when specimens of even size are compared. The labial folds are constantly shorter and the upper lobe of the caudal is longer in *S. lalandii.* The last named differences do not appear to vary with age and may be determined by making proportional measurements. The claspers on comparatively small specimens of *S. lalandii* are much larger and better developed than they are on specimens of the same size of *S. longurio,* which indicates that sexual maturity is reached much earlier in *S. lalandii* than in *S. longurio,* and also that the latter probably reaches a larger size.

Recorded from Brazil. Our specimens were purchased in the Colon fish market where this shark is sold to the natives for food.

19. Scoliodon terræ-novæ Richardson. (Plate II, fig. 3.)

Squalus punctatus Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 483 (New York; not of Bloch & Schneider).

Squalus terræ-novæ Richardson, Fauna Bor. Amer., III, 1836, 289 ("Newfoundland", where the species does not occur).

Carcharias terrænovæ Günther, Cat. Fish. Brit. Mus., VIII, 1870, 360.

Scoliodon terræ-novæ Gill, Proc. Ac. Nat. Sci. Phila., 1861, 59; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 43; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 115.

Body moderately robust, head rather broad; snout rather short, broadly rounded, preoral portion 1 to 1.05 in length to eye, its width at nostrils 1.05 in preoral length and 1.1 in length to eye; eye rather small, its diameter somewhat greater than width of nostril; interorbital area convex, 1.05 to 1.15 in snout; nostrils obliquely placed, the outer angles being notably in advance of the inner ones, the inner angles about two-thirds as far from the mouth as from tip of snout, narial valve with a sharply pointed lobe; distance from nostril to eye 3.1 to 3.2 in snout; internarial space 2 times diameter of eye; mouth rather strongly arched, its width at angles 1.2 to 1.25 in preoral part of snout; labial folds short, the upper one notably less than ⅓ the length of the jaw, about ⅔ the length of eye, 3.8 to 4.15 in preoral part of snout and 2.3 to 2.8 in internarial, the lower fold shorter, 6.35 to 6.75 in preoral part of snout; teeth as in *S. longurio;* gill-slits rather narrow, the longest about 2.5 in internarial, 1.1 to 1.15 in distance from eye to outer angle of nostril; first dorsal as in *S. longurio,* its base 2.4 in distance between dorsal fins; second dorsal moderate, its origin over or a little behind middle of base of anal, its base 6.05 to 7.4 in distance between the dorsal fins; upper lobe of caudal very long, pointed, 3.85 in total length, the lower lobe broad, 6.4 to 6.75 in the upper lobe; anal fin with concave margin, its base 1.85 to 1.95 in distance from anal to base of caudal; ventral fins small, inserted equidistant from axil of pectoral and posterior margin of base of anal, the claspers about ⅔ the length of the fins in specimens 360 mm. in length; pectoral fins moderate, the posterior margin little concave, reaching about opposite middle of base of dorsal.

Color bluish gray above; pale below.

Two small specimens, 360 and 365 mm. in length, were secured. We have compared these specimens from Jamaica, and North and South Carolina with which they agree perfectly. This species and *S. lalandii* have been considered identical by some recent authors, but the two species are less closely related than *S. lalandii* and *S. longurio.*

The body is more robust, the head and snout are broader and less sharply pointed and the labial folds are shorter than in the other species, *S. lalandii* being intermediate in these characters. The upper lobe of the caudal is notably longer than in *S. longurio,* agreeing in this respect with *S. lalandii.* The structure of the dermal armature of the skin appears to be identical in all 3 species, each denticle being three-keeled.

Known from Labrador to Brazil. Our specimens were purchased in the Colon fish market.

7. Genus **Galeocerdo** Müller & Henle.

Galeocerdo Müller & Henle, Plagiostomen, 1841, 59 (type *Galeocerdo trigrinus* Müller & Henle).

Body robust, elongate; head depressed; snout short, broad; mouth large and broad; labial folds present on both jaws; teeth similar in both jaws, large, oblique, coarsely serrate on both margins; nictitating membrane present; spiracles small, behind the eyes, first dorsal above the space between pectorals and ventrals; second dorsal above anal; caudal pits present, the fin with a double notch.

A single species is known, which grows large and is one of the fiercest sharks.

20. Galeocerdo arcticus (Faber).

Squalus arcticus Faber, Naturgesch. Fische Islands, 1829, 17.

Galeus maculatus Ranzani, Novi Comment. Ac. Sci. Inst. Bonon., V, 1840, 7, Pl. I (Brazil).

Galeocerdo tigrinus Müller & Henle, Plagiostomen, 1841, 59, Pl. XXIII; Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 179 (Panama Bay); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 32.

Galeocerdo arcticus Müller & Henle, Plagiostomen, 1841, 60, Pl. XXIV; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 148.

Carcharias fasciatus Bleeker, Verh. Bat. Gen., Plagios., XXIV, 1852, 37 (Indian Archipelago).

Boreogaleus arcticus Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 411.

Galeocerdo maculatus Poey, Repertorio, II, 1868, 453.

Galeocerdo rayneri Macdonald & Barron, Proc. Zoöl. Soc. London, 1868, 368, Pl. XXXII ("Southern Seas").

Galeocerdo obtusus Klunzinger, Verh. Zoöl.-Bot. Ges. Wien, XXI, 1871, 664 (Red Sea).

Galeocerdo fasciatus Kampen, Bull. Dept. Agric. Indes-Neerl., VIII, 1907, 9 (Indian Archipelago).

Body robust; head depressed; tail compressed; snout very short and broad, outline in front of eyes nearly semicircular; nostrils remote, the interspace greater than length of snout; spiracles small, elongate, placed behind the eye; eye moderate, elongate, pupil round; mouth large, its width greater than length of snout; a long labial fold on upper jaw; teeth alike in both jaws, broad oblique cusps on broad bases, edges denticulate; origin of dorsal a short distance behind base of pectorals; second dorsal a little larger than anal and a little in advance of it; caudal long, slender, pointed, from 3 to 4 in total length, lower lobe produced, acute; ventral fins small, inserted nearer the second than the first dorsal; pectoral fins large, the posterior margin concave.

Color of young light brownish with numerous irregular spots of darker along sides and on fins, the spots often more or less coalesced and forming vertical bars. These markings fade with age as the ground color darkens until the body becomes nearly a uniform grayish brown.

This species was not taken by us, but large sharks were seen which probably were tiger sharks. The species is not recorded from the Atlantic coast of Panama, but it was once taken on the Pacific coast by the "Albatross."

Known from tropical and temperate seas.

Family V. Cestraciontidæ.

The Hammer-head Sharks.

This family resembles the species of the genus *Carcharhinus,* differing in the peculiar modification of the head, which is greatly depressed and broadly expanded, hammer-shaped. The eyes are far apart, being situated on the lateral margins of the expanded head; nictitating membrane present; no spiracles; nostrils remote from each other and distinct from the mouth; labial folds rudimentary; teeth compressed; first dorsal fin large, in advance of ventrals; second dorsal and anal small, opposite; lower lobe of caudal prominent. A single genus is known.

8. Genus **Cestracion** Klein.

Cestracion Klein, Neuer Schauplatz, etc., III, 1776, 523 (type *Squalus zygæna* Linnæus).

Sphyrna Rafinesque, Ind. d'Itt. Sicil., etc., 1810, 46, 60 (type *Squalus zygæna* Linnæus).

Body elongate, compressed; head much depressed, with a broad expansion on each side, more or less hammer-shaped; eyes far apart, placed on lateral edges of the broadly expanded head; nictitating membrane present; no spiracles; mouth inferior, strongly arched; labial folds rudimentary; teeth compressed, more or less triangular, with broadly expanded bases and a notch on posterior edge; first dorsal behind the origin of the pectorals and in advance of the ventrals; second dorsal over the anal; caudal pits present; lower lobe of caudal produced.

KEY TO THE SPECIES.

a. Head very broad, its greatest width about 3 in total length, anterior outline irregular, a deep concavity over each nostril; a long nasorial groove present; origin of first dorsal a little in advance of axil of pectoral. *zygæna*, p. 58.

aa. Head less broadly expanded, its width 4.5 and 5.5 in total length, anterior outline regular, no concavity over the nostrils; nasorial groove short or obsolete; origin of first dorsal behind vertical from axil of pectoral.

b. Front margin of head broadly rounded; origin of dorsal slightly behind axil of pectorals; distance from end of base of second dorsal to caudal pit not quite as long as base of first dorsal; the posterior acute angle of second dorsal reaching ⅔ the distance to caudal pit; ventral fins inserted nearer tips of lower angle of pectorals than origin of anal. *tudes*, p. 59.

bb. Front margin of head more strongly convex; origin of dorsal at vertical from tips of lower angles of pectorals; distance from end of base of second dorsal to caudal pit longer than base of first dorsal; the posterior acute angle of second dorsal reaching scarcely half way to caudal pit; ventral fins inserted nearer origin of anal than tips of lower angle of pectorals. *tiburo*, p. 60.

21. Cestracion zygæna (Linnæus).

Squalus zygæna Linnæus, Syst. Nat., Ed. X, 1758, 234 (Europe; America).

Cestracion zygæna Klein, Neuer Schauplatz, etc., III, 1776, 524, 706; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 157, Pl. I, figs. 1-3.

Sphyrna zygæna Rafinesque, Ind. d'Itt. Sicil., etc., 1810, 46; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 45; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 13 (Panama Bay).

Zygæna zygæna Cuvier, Règne Animal, Ed. I, II, 1817, 127.
Zygæna malleus Valenciennes, Memoir. Mus. Hist. Nat., IX, 1822, 225.
Sphyrichthys zygæna Thienemann, Lehrb., III, 1828, 408.
Sphyrnias zygæna Gray, Chondropterygii, 1851, 49.
Sphyra malleus Hoeven, Handb., II, 1858, 68.

Body elongate, compressed; head very broad, greatly expanded, the front margin a broad, irregular curve, a deep concavity at nostril; head to first gill-slit 1.6 to 1.7 in width of head or hammer; width of head from 3 to 3.25 in total length; nostril close to eye, with a long groove on margin of snout, extending more than half way to middle of snout; eye rather large, distance from nostril less than its diameter; mouth moderate, its width 1.1 to 1.15 in preoral length of snout; teeth similar in both jaws, oblique, cusps triangular, the lateral ones with a notch at base posteriorly; first dorsal high, its height much greater than length of its base, outer margin concave, the lower angle somewhat produced, acute, origin a little in advance of axil of pectoral, base 1.9 to 2.2 in distance between dorsal fins; second dorsal small, its posterior angle notably produced, reaching about ¾ the distance to caudal pit, base 5.6 to 6.3 in distance between dorsal fins; upper lobe of caudal long, rather acute, 3.1 to 3.2 in total length; lower lobe produced, acute, 2.75 to 2.85 in the upper; anal fin a little longer than the second dorsal, its outer margin deeply concave, origin a little in advance of the second dorsal, base 1.2 in distance to base of lower lobe of caudal; ventral fins small, inserted slightly more than half as far from origin of anal as from origin of pectorals; pectoral fins moderate, scarcely reaching to end of base of first dorsal, the lower angle not produced and the posterior margin of fin not concave.

Color grayish above; pale below.

We have at hand 5 specimens, ranging in length from 560 to 1350 mm. Our specimens are all from the Atlantic side. The species was not taken on the Pacific side, although reported abundant there by Gilbert and Starks (1904).

Known from tropical and temperate seas. Four specimens were secured in the Colon fish market and the largest one with hook and line at Porto Bello.

22. Cestracion tudes (Cuvier).

Zygæna tudes Cuvier, in Valenciennes, Memoir. Mus. Hist. Nat., IX, 1822, 225, Pl. XII, fig. 1 (Nice).

Sphyrna tudes Müller & Henle, Plagiostomen, 1841, 53; Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 105; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 44; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 13 (Panama Bay).

Sphyrnias tudes Gray, Chondropterygii, 1851, 53.

Cestracion tudes Duméril, Elasmobranches, 1865, 384; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 159.

Body slender, compressed; head moderately expanded, the front margin evenly and broadly rounded, no concavity over nostril; head to first gill-slit 1.2 in its greatest width, the width of hammer 4.5 in total length; nostril close to eye, with a short rudimentary groove not longer than eye; eye moderate, distance from nostril less than its diameter; mouth moderate, its width 1.25 in preoral length; teeth unlike in the jaws, the upper ones with compressed cusps with a sharp apex, broad base and a notch posteriorly, the lower teeth much narrower, bases broad and apices slightly recurved, no serrations; first dorsal rather high and short, its base 1.9 in the height, the lower angle somewhat produced, acute, origin slightly behind axil of pectorals, base 2.4 in distance between dorsal fins; second dorsal very small, its lower angle produced, acute, reaching ⅔ the distance to caudal pit; distance between end of base of fin and caudal pit a little shorter than base of first dorsal; upper lobe of caudal long, not sharply pointed, 3.3 in total length; lower lobe exserted, 2.75 in the upper; anal fin nearly twice as long as the second dorsal, its outer margin moderately concave, origin in advance of second dorsal, its base .75 in distance to base of caudal; ventral fins moderate, inserted about an eye's diameter nearer tips of lower angle of pectorals than origin of anal; pectorals moderate, not reaching end of base of first dorsal.

Color grayish above, pale below.

A single specimen, 510 mm. long, was secured on the Atlantic side. Although reported as common on the Pacific side by Gilbert & Starks (1904), it was not obtained there by us.

Known from all tropical seas. Our specimen was secured in the Colon fish market.

23. Cestracion tiburo (Linnæus).

Squalus tiburo Linnæus, Syst. Nat., Ed. X, 1758, 234 (America).

Cestracion tiburo Klein, Neuer Schauplatz, etc., III, 1776, 526; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 160, Pl. I, figs. 4-6.

Sphyrna tiburo Rafinesque, Ind. d'Itt. Sicil., etc., 1810, 47; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 44, Pl. V, fig. 19; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 13 (Panama Bay).

Cestrorhinus tiburo Blainville, Bull. Soc. Philom., 1816, 121.

Zygæna tiburo Valenciennes, Memoir. Mus. Hist., Nat. IX, 1822, 226, Pl. XII, figs. 2^a, 2^b.

Platysqualus tiburo Swainson, Nat. Hist. & Class. Fish., II, 1839, 318.

Sphyrnias tiburo Gray, Chondropterygii, 1851, 50.

Reniceps tiburo Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 412.

Body slender, compressed; head less broadly expanded than in related species, the front margin evenly and rather sharply curved, more strongly convex than in *C. tudes*, no concavity over nostril; head to first gill-slit 1.05 to 1.15 in its greatest width, the width of hammer 5.3 in total length; nostril close to eye, groove very short, not longer than eye; eye moderate, distance from nostril scarcely equal to its diameter; mouth moderate, its width 1.3 to 1.55 in preoral length; teeth in the jaws broad-based, the cusps compressed, oblique on lateral portion of jaws, the upper ones somewhat broader, posteriorly with a very deep notch; first dorsal nearly twice as high as long, the lower angle little produced, acute, origin at vertical from tip of lower angle of pectorals, the base 2.9 in distance between dorsal fins; second dorsal rather small, posterior angle produced, reaching a little less than half way to caudal pit; distance from end of base of second dorsal to caudal pit longer than base of first dorsal; upper lobe of caudal quite long, pointed, 3.55 to 3.8 in total length; lower lobe well developed, 2.75 to 2.9 in the upper; anal fin nearly 2 times as long as the second dorsal, its outer margin gently concave, origin in advance of second dorsal, base .65 to .85 in distance to base of caudal; ventral fins moderate; the claspers in a male 610 mm. long more than twice the length of the fins, fins inserted an eye's diameter nearer origin of anal than tips of lower angle of pectorals; pectoral fins rather large, reaching about opposite middle of base of dorsal.

Color grayish above; pale below. Our largest specimen with a few small, round, dark spots on sides.

Three specimens, respectively 275, 320 and 610 mm. in length, are at hand. The smallest one is an embryo which still shows the umbilical attachment.

Known from nearly all temperate and tropical seas. Our largest specimen is from Colon on the Atlantic side, and the other 2 specimens are from the Pacific, from Chame Point, collected by Robert Tweedlie.

Family VI. Vulpeculidæ.

The Thresher Sharks.

Body moderately elongate; head short; tail very long; mouth crescent-shaped; teeth in both jaws equal, of moderate size, compressed, triangular, not serrate; gill-slits 5, the last one above base of pectoral; no nictitating membrane; spiracles behind eyes, minute or absent; first dorsal large, midway between pectorals and ventrals; second dorsal and anal small; caudal fin exceedingly long, about as long as the rest of the body; caudal pits present; lower lobe moderately developed; pectoral fins large, falcate.

A single genus and species reaching a large size.

9. Genus **Vulpecula** Valmont.

Vulpecula Valmont, Dict. Hist. Nat., III, 1768, 740 (type *Vulpecula marina* Valmont = *Squalus vulpinus* Bonnaterre = *Squalus vulpes* Gmelin).

Alopias Rafinesque, Caratteri, etc., 1810, 12 (type *Alopias macrourus* Rafinesque).

Alopecias Müller & Henle, Sitzb. k. Ak. Wiss. Berlin, 1837, 114 (Amended orthography).

The characters of the genus are included in the family description.

24. **Vulpecula marina** Valmont.

Vulpecula marina Valmont, Dic. Hist. Nat., III, 1768, 740 (After Salviani and other early writers); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 30, Pl. VII, figs. 1-3, Pl. XLII (brain).

Squalus vulpes Gmelin, Syst. Nat., I, 1789, 1496 (Mediterranean).

Squalus vulpinus Bonnaterre, Tableau Encyclo., Ichth., 1788, 9, Pl. LXXXV, fig. 349 (Mediterranean).

Alopias macrourus Rafinesque, Caratteri, etc., 1810, 12 (Sicily).

Alopecias vulpes Müller & Henle, Sitzb. k. Ak. Wiss. Berlin, 1837, 114.

Alopias vulpes Bonaparte, Icon. Fauna Ital., Pesci, 1841, with plate; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 45.

This shark is not as yet recorded from Panama, but it is widely distributed and it undoubtedly at times frequents the shores of the Isthmus. The species is readily recognized by the excessively long caudal fin, which is more than half the total length.

Family VII. Isuridæ.

The Mackerel Sharks.

Body robust; head conical; tail slender, the peduncle depressed, with lateral folds and caudal pits; nostrils oblique, near the mouth but not confluent with it; eyes without nictitating membrane; mouth broad; teeth large; spiracles small or wanting; gill-slits wide, all in front of pectorals; first dorsal large; second dorsal and anal small; pectorals large, falcate.

10. Genus **Carcharodon** Smith.

Carcharodon Smith, Proc. Zoöl. Soc. London, 1837, 86 (type *Carcharodon capensis* Smith = *Squalus carcharias* Linnæus).

Body very robust anteriorly; head conical; caudal peduncle strong, depressed; teeth large, compressed, serrate, triangular, the upper teeth broadest; first dorsal large, nearly midway between pectorals and ventrals; second dorsal and anal very small; pectorals large.

25. Carcharodon carcharias (Linnæus).

Squalus carcharias Linnæus, Syst. Nat., Ed. X, 1758, 235 (Europe).

Carcharodon rondeletii Müller & Henle, Plagiostomen, 1838, 70 (Mediterranean and Atlantic Ocean).

Carcharias atwoodi Storer, Proc. Bost. Soc. Nat. Hist., III, 1848, 71 (Provincetown).

Carcharodon capensis Smith, Ill. Zoöl. S. Africa, Pisces, IV, 1849, Pl. IV (Cape of Good Hope).

Carcharodon carcharias Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 875; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 50; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 32, Pl. V, figs. 5-9.

This ferocious shark, which has gained for itself the name, "Man-eater", is not recorded from either coast of Panama, but, since it is cosmopolitan in temperate and torrid seas, it may be expected there. It is said to reach a length of about 30 feet. This shark may be distinguished from related species by the large, triangular, serrate teeth, the other species having smaller teeth which are scarcely, or not, triangular and not serrate.

Order III. Cyclospondyli.

Family VIII. Squalidæ.

The Dog-fishes.

Body elongate; head depressed; eyes lateral, no nictitating membrane; nostrils inferior, separate, remote from the mouth; mouth rather large, inferior, with labial folds and a deep groove at each angle; spiracles present; gill-slits 5, all in front of pectoral; dorsal fins 2, each preceded by a spine; no anal fin.

A single genus and species has been recorded from Panama.

11. Genus **Squalus** Linnæus.

Squalus Linnæus, Syst. Nat., Ed. X, 1758, 233 (including all sharks).

Squalus Rafinesque, Caratteri, etc., 1810, 13 (first restriction of the name *Squalus* to species with spiracles and no anal fin; type *Squalus acanthias* Linnæus).

Acanthorhinus Blainville, Bull. Soc. Philom., 1816, 263 (type *Squalus acanthias* Linnæus).

Acanthias Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 131 (type *Squalus acanthias* Linnæus).

Body rather slender; head flattened below; snout produced, tapering; nostrils transverse, inferior, remote from mouth; spiracles behind eyes; mouth wide, little arched, with a deep groove and with labial folds at each angle; teeth compressed, alike in both jaws, with oblique cusps; dorsal spines not grooved on sides; first dorsal near the pectorals; second dorsal behind ventrals; caudal pits present; lower lobe of caudal produced.

A single species was once reported, by name only, from Panama by Günther (Trans. Zoöl. Soc. London, 1868, p. 396) as *Acanthias vulgaris*. There is considerable doubt as to which species of *Squalus* this specimen actually belonged. Gilbert & Starks (Memoir. Cal. Ac. Sci., IV, 1904, p. 13) refer it doubtfully to *S. sucklii* (Girard). Garman's recent work (Memoir. Mus. Comp. Zoöl., XXXVI, 1913, pp. 191 to 196) does not appear to shed much light on the subject. Three species are recognized by this author but he fails to give the distribution as understood by him. We too are unable to contribute further information. We offer herewith Garman's key to the species of

Squalus, as it is probable that one or more of the species may be found on the coasts of Panama.

Dorsal spine behind and remote from the inner angle of the pectoral. *acanthias.*

Dorsal spine opposite or a little behind the inner angle of the pectoral. *sucklii.*

Dorsal spine near the axil of the pectorals, between the inner margins. *fernandinus.*

Order IV. Batoidei.

Family IX. Pristidæ.

The Sawfishes.

Body elongate, depressed; snout produced into a long thin, flat process, from ¼ to ⅓ the total length, armed with a series of strong teeth along each edge; teeth in jaws small, paved; gill-slits moderate, inferior; spiracles wide, behind the eye; nostrils inferior; no tentacles; eye without nictitating membrane; dorsal fins 2, large, the first nearly opposite ventrals; caudal fin well developed, bent upward; a fold along each side of tail; pectoral fins moderate, the front margin not extending to head.

A single genus is known. The sawfishes dwell on the bottom. The large saw-like rostrum probably is not used extensively as an offensive weapon, but it does constitute an effective defensive weapon, as the fish is able to strike from side to side with great force.

12. Genus **Pristis** Klein.

Pristis Klein, Neuer Schauplatz, etc., VII, 1779, 403 (type *Squalus pristis* Linnæus).

The characters of the genus are included in the family description.

key to the species.

a. Origin of first dorsal notably in advance of the ventrals; lower lobe of caudal small; 17 to 23 teeth on each edge of rostrum. *microdon,* p. 66.

aa. Origin of first dorsal over origin of ventrals; lower lobe of caudal absent; 24 to 32 teeth on each edge of rostrum. *pectinatus,* p. 66.

26. Pristis microdon Latham.

Pristis microdon Latham, Trans. Linn. Soc. London, II, 1794, 280, Pl. XXVI, fig. 4.

Pristis perotteti Müller & Henle, Plagiostomen, 1838, 108 (Senegal River).

Pristis zysron Bleeker, Nat. Tijds. Ned.-Ind., III, 1852, 441.

Pristis zephyreus Jordan & Starks, Proc. Cal. Ac. Sci., 2nd Ser., V, 1895, 383 (Mazatlan); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 14 (Panama).

Body depressed, the depth between the dorsals scarcely less than the width; caudal peduncle much depressed, with a lateral keel; saw long, tapering, its width at distal pair of teeth 2 times in its width at basal pair of teeth, length of rostrum to eye about 3.4 in total length; rostral teeth very variable in length among specimens and regardless of sex, varying from 4 to 14 mm. in specimens 825 mm. long, each tooth posteriorly with a groove, the teeth not always evenly paired, from 17 to 23 on a side; teeth in the jaws paved, in 70/72 to 72/74 rows; dorsal fins rather large, both of about equal height, the base of the second shorter than that of the first, the posterior margin of each fin deeply concave; the distance between the dorsal fins slightly less than half the length of rostrum to basal pair of teeth; upper lobe of caudal long, acute, lower lobe small; ventral fins inserted about ¾ the length of base of first dorsal behind origin of anterior dorsal fin; pectoral fins broad, the base longer than the fin, extending forward to slightly past anterior gill-slit.

Color dull gray above, white below.

This sawfish is common in the tide streams on the Pacific coast of Panama, but we did not find it on the Atlantic coast. Twenty-two specimens, ranging in length from 800 to 1075 mm., were preserved and nearly all were taken in fresh water at or above the head of tide. No large individuals were seen.

Widely distributed in tropical seas. Our specimens are from the Rio Chorrera, tide stream at Balboa, Rio Bayano and Rio Tuyra.

27. Pristis pectinatus Latham.

Pristis pectinatus Latham, Trans. Linn. Soc. London, II, 1794, 278 ("In the ocean").

Pristis granulosa Bloch & Schneider, Syst. Ichth., 1801, 352 (Havana).

Pristis megalodon Duméril, Elasmobranches, I, 1865, 476, Pl. IX, fig. 4 (Cayenne).

Pristis acutirostris Duméril, Elasmobranches, I, 1865, 479 (Martinique).

This species was not seen by us and it is not recorded from Panama, although it undoubtedly occurs there. Many names have been proposed for this sawfish and the above synonomy is very incomplete. The characters distinguishing this species are included in the foregoing key to the species.

Occurring in tropical and temperate seas. Not as yet recorded from either coast of Panama.

Family X. **Rhinobatidæ.**

The Guitar Fishes.

Body, head and tail depressed; anterior part of body broad, forming together with the broad development of the pectorals a disk which tapers forward, the rayed portion of the pectorals extending opposite gill-slits; tail rather strong, wide at the base, bearing 2 dorsal fins; a moderate to small caudal fin with a dermal fold on each side extending forward on caudal peduncle; spiracles large, close to the eye; nostrils oblique; teeth small, numerous, paved. In the representatives of this family the eggs are hatched within the body of the parent. A single genus is known from Panama.

13. Genus **Rhinobatus** Klein.

Rhinobatus Klein, Neuer Schauplatz, etc., II, 1776, 593 (type *Raja rhinobatus* Linnæus).

Rhinobatos Linck, Mag. Phys. Nat., VI, 1790, 32 (type *Raja rhinobatus* Linnæus).

Body depressed throughout; disk subtriangular, wide posteriorly and passing gradually into the rather pointed snout; the pectorals mostly developed behind shoulder girdle, not extending forward to snout; snout formed by the long rostral cartilage and a vascular area on each side of it; spiracles large, placed immediately behind the eyes, usually with 1 or 2 membranous folds posteriorly; nostrils oblique, wide; dorsal fins behind the ventrals; no subcaudal lobe; ventrals close to the pectorals.

KEY TO THE SPECIES.

a. Rostral cartilage tapering, the ridges separate throughout, gradually converging toward tip of snout; internarial space

about ¾ the width of nostril; color usually uniform grayish above, rarely with small white spots. *leucorhynchus*, p. 68.

aa. Rostral cartilage narrower in middle than at the ends, the ridges separate throughout, converging on basal ⅓ and from thence to tip the interspace is of uniform width; internarial space as broad as nostril; upper parts of body usually with rather few small white spots symmetrically arranged. *percellens*, p. 69.

28. Rhinobatus leucorhynchus Günther.

Rhinobatus leucorhynchus Günther, Proc. Zoöl. Soc. London, 1866, 604 (Panama); Garman, Proc. U. S. Nat. Mus., 1880, 517 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 14 (Panama); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 282.

Body depressed throughout; disk rather broad, its width at broadest point a little less than its length measured from tip of snout to axil of pectoral, the lateral outline of disk on snout slightly concave; snout strong, proportionately longer in the young than in adult, 1.86 to 2.5 in disk measured to tips of pectorals; rostral cartilage strong, tapering, the ridges well separated throughout, but converging toward tip of snout, the interspace distally less than half as wide as posteriorly; eye nearly equal to interorbital in very young, much narrower in adult, 4.4 in snout; interorbital flat or very slightly concave, 3.15 to 4 in snout; spiracles smaller than eye, posteriorly with 2 definite folds of skin, the outer one much the larger; nostrils broad; internarial area about ¾ width of the nostril and ½ as wide as mouth; mouth bent slightly forward in middle, its width 2.1 to 2.4 in snout; teeth paved; median line of back to second dorsal with short low spines, a series of smaller ones on supraorbital and preorbital ridges, a pair of spines (young specimen, 190 mm.) or 2 clusters of spines (adults) on each shoulder, none on snout, these spines all proportionately longer in the young than in the adult; dorsal fins of about the same size and shape, highest anteriorly, the outer posterior margins slightly truncate, the base of the first dorsal 2.5 to 2.6 in distance between the dorsal fins; caudal fin pointed above, the lower lobe not exserted, rounded below; ventral fins moderate, anterior margin convex, posteriorly nearly straight.

Color of specimen (590 mm.) dark gray above, the snout and outer parts of disk paler, no spots or blotches. Lower parts pale, the distal part of snout dusky. Small specimen (190 mm.) generally lighter in color and with a few pale spots sparsely scattered over the upper parts. The distal part of snout not dusky.

Two specimens, respectively 190 and 590 mm. in length, were secured of this rather rare species. We also have examined 2 adult specimens from Mazatlan with which our large specimen agrees perfectly. The young individual differs in several respects from the adults, as shown in the description, but these differences are believed to be due to age.

Known from Mazatlan to Guayaquil, Ecuador. One of our specimens was seined on a sandy beach at Balboa and the other was found in the Panama City market.

29. Rhinobatus percellens (Walbaum).

Raja percellens Walbaum, Artedi Piscium, 1792, 525 (Brazil).

Rhinobatus electricus Bloch & Schneider, Syst. Ichth., 1801, 356 (Brazil).

Rhinobatus undulatus Olfers, Torpedo, 1831, 22 (Brazil).

Rhinobatus marcgravii Henle, Ueber Narcine, 1834, 34 (Brazil).

Rhinobatus percellens Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 63; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 278.

Body depressed throughout; disk moderately broad, its width at broadest point about 1.2 in its length measured from tip of snout to axil of pectoral, the lateral outline of disk on snout slightly concave; snout rather narrow, 2.2 to 2.3 in disk measured to tips of pectorals; rostral cartilage narrower in the middle than at the ends, the ridges separate throughout, converging from fontanel forward for about ⅓ their length, thence parallel on inner edges, space between the ridges about half as broad anteriorly as posteriorly; eye notably narrower than interorbital space, 4.7 to 4.85 in snout; interorbital slightly concave, the orbital ridges somewhat raised, 4.3 to 4.4 in snout; spiracles smaller than eye, posteriorly with 2 definite folds of skin, the outer one notably the larger; nostrils of moderate width; internarial area equal to width of nostril and ½ width of mouth; mouth bent forward slightly in middle, its width 2.3 in snout; teeth and jaws paved; median line of back to first dorsal with a row of short low spines and 5 or 6 very small ones behind first dorsal, a row of small spines on supraorbital and preorbital ridges, a single spine on each shoulder, none on tip of snout; dorsal fins of about the same size and shape, highest anteriorly, the outer posterior margins slightly truncate, the base of

the first dorsal 2.25 to 2.55 in distance between dorsals; caudal fin somewhat pointed above, rounded below, the lower lobe not exserted; ventral fins moderate, the posterior margin gently convex, claspers in male very long, nearly as long as preoral part of snout.

Color of specimens at hand light grayish above, with round white spots which are less numerous and slightly less distinct than in *R. lentiginosus* Garman. The spots are symmetrically arranged, i.e., those occurring on one side of median line have fellows on the opposite side. Lower parts pale; tip of snout with a large triangular dusky blotch.

A rare species on the Atlantic coast of Panama. Two specimens, a male and female respectively 440 and 520 mm. in length, were taken. We have had no specimens from other localities for comparison, but our material agrees quite well with current descriptions, except certain features of the account given by Starks (Leland Stanford Junior University Publications, University Series, 1913, page 5), based on 2 specimens taken at Natal, Brazil, in which he states that the greatest width of the disk is equal to the space from the tip of the snout to the middle of the eyes. In our specimens the distance from the middle of the eyes to tip of snout is nearly exactly equal to half the width of the disk. It is quite probable that an error in statement was made. Starks also states that the vent is midway between tip of snout and base of caudal, whereas in our specimens the vent is much farther forward. The species must vary greatly in color, if all the specimens of various colors described belong to one species. Garman (1913) states that the body may be blotched or plain and that it may be sprinkled with small white dots. Starks gives the ground color as white or light sienna and with brown spots scattered over the upper parts so closely that the ground color shows only as reticulations. White spots which are small and sparsely scattered are also mentioned.

Known from the West Indies to the Plata River. Our specimens are from Toro Point and Colon.

Family XI. **Rajidæ.**

The Skates.

Body and head much depressed, united with the pectorals and forming a rhomboid disk; tail distinct, stout, rather long, with lateral folds; dorsal fins 2, small, both on the posterior half of the tail; eyes and spiracles superior; mouth inferior, small; teeth small, numerous,

in pavement; skin usually more or less rough with small spines and larger tubercles. The species are oviparous, the eggs being laid in large leathery, 4-angled cases, with 2 tubular "horns" at each end.

14. Genus **Raja** Linnæus.

Raja Linnæus, Syst. Nat., Ed. X, I, 1758, 231 (type *Raja batis* Linnæus).

Disk more or less quadrangular to circular; snout more or less produced, with a stout prolongation from the skull as a rostral cartilage; pectoral fins widely separated at snout, not reaching its end; mouth transverse, nearly straight; teeth small, varying from flat to sharp and pointed, usually different in the sexes; tail with a fold along each side; caudal fin membranous; ventral fins deeply notched. A single species of this large genus is recorded from the Isthmus of Panama.

30. Raja equatorialis Jordan & Bollman.

Raja equatorialis Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 150 (Panama Bay); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 74.

Raia equatorialis Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 357.

Disk about a third broader than long, antero-lateral margin concave; snout produced, rather acute, its length less than a third of the disk; interorbital transversely concave, 2.4 in snout; width of mouth 1.5 in pre-nasal part of snout; nasal flaps at angle of mouth deeply fringed; upper surface roughened by small spines near the anterior margins, above the snout, on top of the head and by stronger ones or tubercles in 2 rows on the rostral cartilage, on the orbital ridges, opposite the eyes and in a lateral row on each side of tail; median line of back and tail with alternating sizes of tubercles; a tubercle on each shoulder; dorsal fins small, about 2 in snout; caudal small, not longer than eye.

Color light brown, spotted with paler; the back with obscure reticulations of the ground color, forming honeycomb-like markings, surrounding paler color; an obscure, roundish, dusky blotch at middle of base of pectorals, and a darker one near their posterior base; edges of ventrals, pectorals and snout pale; dark markings on interorbital area and below eye; lower surfaces plain.

This species is known only from the type, a male 355 mm. long, dredged by the Albatross in Panama Bay at a depth of 33 fathoms.

Family XII. Narcaciontidæ.

THE ELECTRIC RAYS.

Head, trunk, electric organs and pectorals forming a smooth, depressed, subcircular disk; tail short, rather stout, with or without a lateral membranous fold; spiracles present; gill-slits small, between the electric organs and the head; electric organs composed of vertical, hexagonal tubes between the pectoral fins and the head, externally indicated by grooves in skin, showing the hexagonal shape of the tubes; nasal valves confluent, forming a quadrangular lobe; skin soft, naked; dorsal fins two, one or none; caudal fin not lobed.

KEY TO THE GENERA.

a. Dorsal fins 2; tail long, with lateral folds.
b. Ventral fins separate; spiracles close behind eyes. *Narcine*, p. 72.
bb. Ventral fins adnate to body; spiracles close behind eyes. *Discopyge*, p. 74.

15. Genus **Narcine** Henle.

Narcine Henle, Ueber Narcine, 1834, 31 (type *Torpedo brasiliensis* Olfers).
Cyclonarce Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 387 (type *Raja timlei* Bloch & Schneider).
Gonionarce Gill, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, 387 (type *Narcine indica* Henle).

Disk nearly circular; tail moderate, with 2 dorsal fins, a well developed caudal fin and with prominent lateral folds; spiracles usually close to eye, with or without a fringe of papillæ; mouth transverse, protractile; teeth in narrow bands, most of them visible when mouth is closed; skin perfectly smooth; ventrals separate from the disk.

KEY TO THE SPECIES.

a. Spiracles notably smaller than the eyes; interorbital space rather narrow, 2.45 in preocular part of snout; ventral fins rather short, reaching less than half the distance from posterior edge of disk to base of caudal. *brasiliensis*, p. 73.
aa. Spiracles much larger than the eyes; interorbital space broad, 1.75 in preocular part of snout; ventral fins large, broad, reaching about half way from posterior edge of disk to caudal fin. *entemedor*, p. 74.

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NARCINE BRASILIENSIS (Olfers).
From a specimen 215 mm. in length.

31. Narcine brasiliensis (Olfers). (Plate III.)

Torpedo brasiliensis Olfers, Torpedo, 1831, 19, Pl. II, fig. 4 (Brazil).

Torpedo bancrofti Griffith, in Cuvier, Animal Kingdom, X, 1834, 649, Pl. XXXIV (Jamaica).

Narcine brasiliensis Henle, Ueber Narcine, 1834, 31, Pl. I, figs. 1-2; Müller & Henle, Plagiostomen, 1841, 129; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 78, Pl. XIII, figs. 35 & 35a; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 297, Pl. XXVI, figs. 2 & 3.

Narcine nigra Duméril, Rev. Mag. Zoöl., IV, 1852, 272 (Brazil).

Torpedo pictus Gronow, Cat. Fish, 1854, 13 (Antilles).

Narcine corallina Garman, Bull. Mus. Comp. Zoöl., VIII, 1881, 234 (Florida).

Narcine umbrosa Jordan, Proc. U. S. Nat. Mus., 1884, 105 (Key West).

Narcine brasiliensis bancrofti Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 298, Pl. XXVI, fig. 2.

Narcine brasiliensis corallina Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 298, Pl. XXVI, fig. 3.

Disk nearly circular, its width a little greater than its length; tail short, rather stout, depressed, with a well developed membranous fold on each side, extending forward to end of first dorsal, distance from vent to tip of caudal fin a little more than half the total length; eyes moderate, not very remote, the interspace 2.45 in preocular part of snout; spiracles nearly as large as eyes, immediately behind orbit, surrounded by a row of prominent papillæ; nostrils rather small, near the mouth, confluent; mouth rather small, transverse, its width 2.5 in preocular part of snout, slightly behind vertical from anterior margin of eyes, preoral length .9 in preocular part of snout; teeth small, the bands narrow, each tooth with a small pointed denticle, directed inward; skin perfectly smooth; origin of first dorsal at vertical from end of base of ventrals; second dorsal similar to the first and of equal size, reaching beyond base of caudal fin when depressed; caudal fin nearly as deep as long, nearly straight on posterior margin, the upper angle a little longer and more acute than the lower; ventral fins broad, free from pectorals, with convex margins; claspers of male, 216 mm. long, reaching end of fin, less than half the distance from posterior margin of disk to base of caudal.

Color nearly uniform dark grayish above; pale below; a dark triangular area in advance of each eye; the margin of the ventral fins pale when seen from above.

A single specimen, 215 mm. in length, was seined from shallow water. Much color variation exists among specimens, the one at hand being among the most uniformly colored ones. Some specimens are grayish or brownish and are marked with darker bars and blotches, others are orange or red with dark brown bands and spots, and still others are marked by rings formed by small dark dots.

Known from North Carolina to Brazil. Our specimen is from Colon.

32. Narcine entemedor Jordan & Starks.

Narcine entemedor Jordan & Starks, in Jordan, Proc. Cal. Ac. Sci., 2nd Ser., V, 1895, 386 (Mazatlan); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 15 (Panama Bay).

This ray, although twice taken and recorded from Panama Bay, was not seen by us. It appears to differ from *N. brasiliensis* in having spiracles which are much larger than the eyes, instead of notably smaller; the interorbital space appears to be wider, being contained 1.75 in preocular part of snout; the mouth is probably a little wider, 2.25 in preocular part of snout; and the ventral fins appear to be broader and longer, ending midway between posterior edge of disk and caudal fin. The color is pale olive-brown, a little clouded with darker; head with dusky dots; second dorsal edged with pale.

16. Genus **Discopyge** Tschudi.

Discopyge Tschudi, Fauna Peruana, 1846, 32 (type *Discopyge tschudii* Tschudi).

Disk circular, about half the total length; preoral section short; a large electric organ between head and each pectoral; mouth small; teeth small, in narrow bands; nostrils near the mouth, confluent; eyes small; spiracles immediately behind eyes; gill-slits narrow; skin entirely smooth; tail depressed, with prominent lateral folds; dorsal fins 2, subequal; ventral fins large, free from the disk.

33. Discopyge ommata Jordan & Gilbert.

Discopyge ommata Jordan & Gilbert, in Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 151 (Panama Bay); Jordan & Evermann, Bull. U. S. Nat. Mus.,XLVII, 1896, 78; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 15.

Disk subcircular, little wider than long; snout broadly rounded; eyes small; spiracles smaller than the eyes, close behind orbit, fringed

with prominent papillæ; mouth transverse, rather small; teeth flat, each with a small denticle, directed inward; origin of first dorsal a little in advance of axil of ventrals; second dorsal a little narrower than the first; caudal fin rounded, the upper angle a little longer than the lower; ventral fins very broad, adnate behind, ending about midway between their origin and tip of caudal fin.

This species, although taken at Panama twice, was not seen there by us.

Known only from the Pacific coast of Panama.

Family XIII. **Dasybatidæ.**

The Sting Rays.

Body, head and pectorals depressed, altogether forming a broad disk, the pectorals meeting in front of the cranium without a supporting rostral cartilage; spiracles large, close behind eye; nasal valves with a broad flap, confluent across a narrow isthmus and reaching mouth; mouth transverse, more or less curved; teeth small, numerous, in pavement, usually with ridges or tubercles; gill-slits small; skin smooth or rough with spines or tubercles or both; tail distinct, sometimes very long and whip-like, sometimes short, bearing a serrated spine in nearly all the genera, sometimes bearing a single dorsal and usually a vertical fold of skin either above or below, or both; ventrals small, placed below posterior part of pectorals.

KEY TO THE GENERA.

a. Tail very long, whip-like, without a fin fold at end. *Dasybatus,* p. 75.

aa. Tail about equal to or longer than disk, but not whip-like; rayed caudal fin present.

b. Caudal fin narrow, more or less pointed; tail longer than the disk. *Urotrygon,* p. 82.

bb. Caudal fin broader, broadly convex posteriorly; tail a little shorter than the disk. *Urobatis,* p. 85.

aaa. Tail very small, much shorter than the disk, without a rayed fin. *Pteroplatea,* p. 86.

17. Genus **Dasybatus** Klein.

Dasybatus Klein, Hist. Pisc. Miss., III, 1742, 34; and Neuer Schauplatz, etc., I, 1775, 991 (type *Dasybatus marinus* Klein).

Dasyatis Rafinesque, Caratteri, etc., 1810, 16 (type *Dasyatis ujo* Rafinesque).

Trigonobatus Blainville, Bull. Soc. Philom., 1816, 112 (type *Raia pastinaca* Linnæus).

Trygon Cuvier, Règne Animal, Ed. I, II, 1817, 136 (type *Raia pastinaca* Linnæus).

Disk subquadrangular to subcircular; tail long, whip-like, with a strong serrated spine, with or without dermal fin folds behind the spine; upper surface of disk and tail usually more or less spinous or prickly, rarely smooth; mouth usually with a few papillæ on the inside at base of lower jaw; teeth small, paved; no rayed dorsal fin, pectorals meeting in front of skull.

KEY TO THE SPECIES.

a. Tail with a narrow free membranous fold above and a broader one below.

b. Disk quadrangular, the antero-lateral margins straight, meeting in a broad angle at tip of snout; snout not exserted, blunt. *say*, p. 77.

bb. Disk subcircular, the antero-lateral margins slightly concave; tip of snout prominently produced, pointed. *sabinus*, p. 77.

aa. Tail with a low keel above and a free fold below.

c. Tip of snout produced, extending in the form of a broad-based triangle beyond the antero-lateral margins of the disk; tail nearly 3 times the length of the disk; back with a median row of prominent, depressed spines, extending from head to caudal spine, a short row of spines on each soulder. *guttatus*, p. 78.

cc. Snout not notably produced, the antero-lateral margins of disk meeting in a broad angle at tip of snout.

d. Tail more than 2 times the length of the disk; a median row of blunt spines extending from head to shoulder girdle, 2 spines far removed, much farther back, and 1 or 2 spines on each shoulder; skin otherwise perfectly smooth. *longus*, p. 79.

dd. Tail less than 2 times the length of the disk; skin smooth in young, adults with a median row of depressed tubercles on back and a short row on each shoulder. *hastatus*, p. 80.

aaa. Tail without a keel or fold above, with a low keel below; disk nearly circular; upper surface covered with low broad tubercles, one greatly enlarged tubercle with radiating grooves on each shoulder. *schmardæ*, p. 81.

34. Dasybatus say (Le Sueur).

Raja say Le Sueur, Journ. Ac. Nat. Sci. Phila., I, 1817, 42, with plate (New Jersey).

Trygon sayi Müller & Henle, Plagiostomen, 1841, 166.

Myliobatis sayi De Kay, Fauna N. Y., Fishes, 1842, 376.

Dasyatis sayi Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 48.

Dasybatus say Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 396.

Disk quadrangular, a little wider than long, the antero-lateral margin straight, meeting in a blunt angle at tip of snout, the outer and posterior angles rounded; mouth with 5 papillæ at base; body and tail smooth, with 3 spines on median line of back behind head and 3 on base of tail; tail about 1.75 times the length of the disk, with a strong serrated spine, a short low fold behind the spine and a longer and broader one below the tail, extending backward from the base of the spine; ventrals rounded, reaching well beyond the disk.

Color yellowish brown above; whitish below.

This species was not seen on the isthmus by us and it is not recorded from there, but its range brings it within the scope of the present work. The above description is based on a specimen from Texas, 310 mm. in length, the disk being 125 mm. long and 130 mm. broad.

Known from New York southward to Brazil.

35. Dasybatus sabinus (Le Sueur).

Trygon sabina Le Sueur, Journ. Ac. Nat. Sci. Phila., IV, 1824, 109 (Florida).

Dasyatis sabinus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 49.

Dasibatis sabina Garman, in Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 68.

Dasybatus sabinus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 397.

Disk circular at sides, antero-lateral margins slightly concave, the tip of snout rather pointed and notably exserted; mouth wavy, with 5 small papillæ at base; top of head and median portion of the back sometimes roughened by small spines and usually with a row of sharp, elongate, tubercles on median line of back and 1 or a pair on each shoulder, the specimen at hand is perfectly smooth, having a single elongate, tubercles on median line of back and 1 or a pair on each of body, depressed from base of caudal spine, from thence round; caudal spine large and strongly serrate, with a narrow dermal fold above, back of spine, and a much broader one below; the tail usually

rough with prickles, but not in the specimen before us; ventral fins reaching beyond disk, the outer angle rather sharp, the inner angle rounded.

Color brownish above, the wing-like expansions paler; white below. The species is not recorded from the Isthmus of Panama and it was not taken there by us, but its range of distribution brings it within the scope of the present work. The above description is based on a specimen from Florida, 320 mm. in length, the disk being 160 mm. long and 175 mm. broad.

Known from North Carolina to Brazil, entering fresh water.

36. Dasybatus guttatus (Bloch & Schneider).

Raja guttatus Bloch & Schneider, Syst. Ichth., 1801, 361 (Brazil).

Trygon gymnura Müller, Ermann's Reise um die Erde, 1835, 25, Pl. XIII (Brazil).

Trygon tuberculata Günther, Cat. Fish. Brit. Mus., VIII, 1870, 480 (In part).

Dasibatis tuberculata Garman, in Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 66.

Dasyatis gymnura Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 84.

Dasybatus guttatus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 391.

Disk more or less quadrangular, a little broader than long, the length 1.1 in the width, the antero-lateral margins straight, tip of snout notably produced and extending in the form of a broad-based triangle beyond the straight antero-lateral margins of the disk; eyes moderate, rather remote, interorbital space 2.05 in preocular part of snout; spiracles about as large as eyes and immediately below and behind the orbit; nostrils directly in front of mouth, with a broad flap reaching mouth; mouth transverse, abruptly curved, the lower jaw with a broad notch on median line and the upper one with a tip projecting into the notch, 3 papillæ on inside of mouth at base of lower jaw, width of mouth 2.9 in preocular length of snout; teeth in pavement, smooth, more or less diamond-shaped; gill-slits small, the longest about ⅔ the length of eye; a median row of prominent, depressed spines on median line of back, extending from nape nearly to origin of caudal spine, increasing in length posteriorly; a row of 2 to 4 short spines on humeral region opposite the intersection of the median

line and the shoulder girdle; skin on interorbital and median portion of back with short, broad tubercles, the tail beyond caudal spine also roughened by short tubercles; tail nearly 3 times the length of disk, 1.35 in total length, depressed in advance of caudal spine, thence round, with a low keel above for a short distance behind caudal spine, below with a free fin fold, extending forward to base of caudal spine; ventral fins rather high anteriorly, the posterior margin and angle rounded.

Color uniform pale gray above; white below; fin folds black.

One specimen, a female, 1040 mm. in total length, was secured.

Known from the West Indies to Brazil. Our specimen is from the Colon fish market.

37. Dasybatus longus (Garman).

Trygon longa Garman, Bull. Mus. Comp. Zoöl., VI, 1880, 170 (Acapulco; Panama).

Dasibatis longa Garman, in Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 66.

Dasyatis longa Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 85; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 17 (Panama).

Dasybatus longus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 390, Pl. XXXII, figs. 3-4.

Disk broader than long, its greatest length 1.15 in its greatest width, the antero-lateral margins nearly straight; the tip of snout not produced, the margins meeting in a blunt angle; eyes moderate, rather remote, the interspace 2.6 in preocular part of snout; spiracles scarcely as large as eyes, situated immediately below and behind orbit, rather elongate, with a sharp angle anteriorly and posteriorly; nostrils directly in front of mouth, with a broad fold extending from nostril to nostril and back to the gape; mouth small, transverse, its width 2.5 in preocular part of snout; teeth small, more or less definitely diamond-shaped, in pavement, without cusps; gill-slits small, the longest slightly exceeding half the length of eye; a median row of blunt spines behind head, extending to intersection of median line with shoulder girdle, 2 spines much farther back and 1 or 2 very short blunt spines on humeral region opposite the intersection of the median line and shoulder girdle; body and tail elsewhere perfectly smooth; tail more than twice the length of disk, 1.35 in total length, depressed in advance of caudal spine and compressed for same distance

behind it, thence round; upper edge of tail behind spine for some distance with a low keel, below an evident free fold (about 3 mm. high in a specimen 1060 mm. in total length), extending forward to below base of caudal spine; ventral fins rather high anteriorly, reduced rapidly in length posteriorly, the posterior margin rounded.

Color uniform brown above; pale below; the fin folds on tail black.

One specimen, a female, 1060 mm. in length was secured. If the specimens identified as this species are all identical, a large variation exists in the number and position of spines on the back and tail, our specimen being among the smoothest known. Most of the specimens described have small prickles on the tail and also on the interorbital and median area of the back, which are wholly wanting in the specimen at hand.

Known from the Gulf of California to Panama. Our specimen is from the Panama City market.

38. **Dasybatus hastatus** (De Kay).

Pastinaca hastata De Kay, Fauna N. Y., Fishes, 1842, 373, Pl. LXV, fig. 214 (Rhode Island).

Trygon hastata Storer, Memoir. Amer. Ac., New Ser., II, 1846, 261.

Dasibatis hastata Garman, in Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 70.

Dasyatis hastata Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 83.

Dasybatus hastatus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 391.

Disk quadrangular, about ¼ wider than long, the antero-lateral margins nearly straight, meeting in a blunt angle at tip of snout, outer and hinder angles rounded; mouth with 3 papillæ; jaws rather strongly curved; body smooth in young, adults with scattered small spines and with a vertebral row of narrow depressed tubercles, directed backward, a short row of tubercles on each shoulder, parallel with the median row; tail about 1.5 times the length of the disk, with a low keel above behind the spine and a long deep fold below extending from the base of the spine backward; ventral almost entirely covered by the pectorals, their hinder margins convex.

Color bluish or olivaceous.

This species was not seen by us, but its range brings it within the scope of the present work.

Known from Rhode Island to Brazil.

39. Dasybatus schmardæ (Werner).

Trygon schmardæ Werner, Zoöl. Jahrbuch (Syst. Abth.), XXI, 1904, 298 (Jamaica).

Dasybatus schmardæ Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 386.

Disk nearly round, slightly broader than long, the greatest length 1.05 in the greatest width, the very small, narrow tip of snout slightly exserted; eyes small; interorbital space 1.5 in preocular part of snout; spiracles more than twice as large as eyes, situated immediately below and behind orbit; nostrils directly in front of mouth, with a broad flap reaching the gape; mouth transverse, a little wavy, the lower jaw with a small indentation at the symphysis and the upper jaw with a tip projecting into it, width of mouth 2.45 to 2.85 in preocular part of snout; 5 papillæ inside of mouth at base of lower jaw; teeth small, in pavement, with rough surface; gill-slits small, the longest about the length of eye; upper surface of disk and tail spinose, with short, rough tubercles, larger on the back and tail than on the distal parts of the disk; the spines on the tail of about the same size as those on median portion of back; 2 greatly enlarged tubercles or bucklers on the humeral region, opposite the intersection of the median line and the shoulder girdle, the point on median line between the bucklers being very nearly the center of the disk; distance between the bucklers equal to ¾ the width of internarial space; spines round, with radiating grooves, diameter exceeding ⅓ the length of eye; the largest specimen at hand with a second enlarged tubercle, immediately behind the first one, but much smaller, this spine not evident in the smaller specimen; caudal spine long, strongly serrate; tail notably depressed in advance of the spine, thence round, with prominent lateral folds at base; no keel or fold above tail behind spine and only a very low keel below; the length of tail not quite twice the length of the disk, 1.5 in total length; ventral fins broad, broadly convex, the anterior angle not reaching beyond disk, their upper surface smooth.

Color uniform dark brown above; pale underneath; teeth very dark.

Two large female specimens, 930 and 1300 mm. in length, and with disk 355 and 560 mm. long and 370 and 568 mm. broad, were secured. They appear to belong to a species known only from the type which was rather imperfectly described.

Recorded only from Jamaica. Our specimens are from Toro Point and Mindi Cut in the Panama Canal.

18. Genus **Urotrygon** Gill.

Urotrygon Gill, Proc. Ac. Nat. Sci. Phila., 1863, 173 (type *Urotrygon mundus* Gill).

Disk subcircular, angles and margins rounded, snout more or less produced; mouth somewhat waved; teeth numerous, crown broader than long; tail longer than body, slender posteriorly, with a serrated spine near middle; caudal fin narrow, pointed; no dorsal fin; back with or without a median series of spines or tubercles; ventral fins more or less triangular, the anterior rays much longer than the posterior ones, directed laterally.

KEY TO THE SPECIES.

a. No enlarged spines or tubercles on the median line of the back; upper surface of disk closely beset with short prickles, largest on the back. *mundus*, p. 82.

aa. One to 8 or a continuous series of enlarged spines on median line of back and base of tail (wanting in very young); skin smooth or more or less prickly.

b. A continuous series of spines on median line of back, extending from head to caudal spine; skin beset with short prickles. *asterias*, p. 83.

bb. No continuous series of spines on median line of back.

c. One or 2 strong spines on middle of back, no spines on tail; skin smooth or somewhat prickly. *goodei*, p. 84.

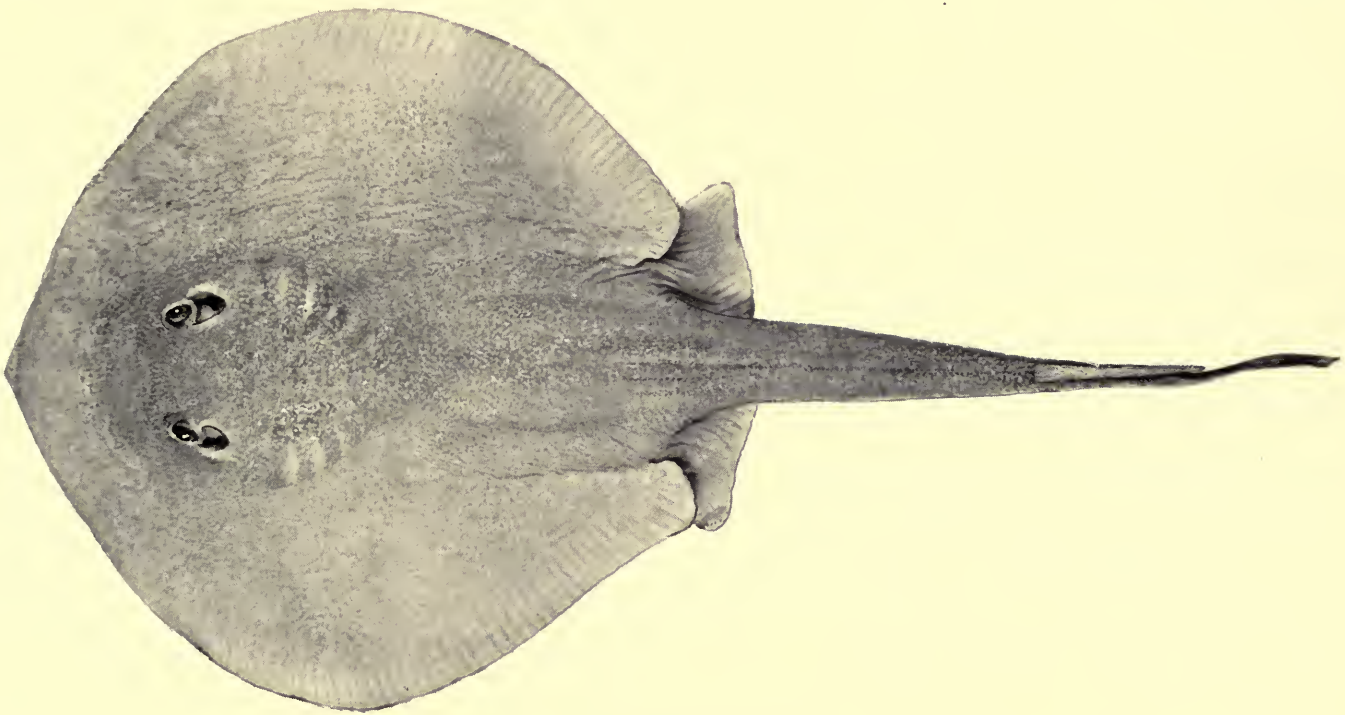
cc. One to 8 sharp spines on tail in advance of caudal spine; skin smooth. *aspidurus*, p. 85.

40. **Urotrygon mundus** Gill. (Plate IV.)

Urotrygon mundus Gill, Proc. Ac. Nat. Sci. Phila., 1863, 173 (Panama); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 406, Pl. XXX, figs. 1 and 2 (In part; plate *U. mundus*).

Urolophus mundus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 81.

Disk somewhat angular, the antero-lateral margins slightly convex, the tip of snout very feebly produced, ending in a broad angle, the margins elsewhere circular, a little broader than long, the width .95 in the greatest length; eyes not very remote, the interspace 3.8 in preocular part of snout; spiracles a little larger than the eyes and situated immediately behind the orbits; mouth scarcely arched, its width 2.45 in preocular part of snout; teeth in pavement, more or



UROTRYGON MUNDUS Gill.
From a specimen 220 mm. in length.

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less diamond shaped, without cusps; upper surface of disk and tail everywhere with prominent prickles, largest on the back, stronger and more prominent than in *U. asterias;* no enlarged spines on median line of back; tail as long as the disk, strongly depressed at base, with a slight lateral keel; caudal spine large, reaching the origin of the caudal fin fold; caudal fin narrow, rounded; ventral fins broad, the posterior margin nearly straight.

Color uniform grayish.

A single female specimen, 215 mm. in length, with a disk 113 mm. broad and 110 mm. long, was sent by Mr. Robert Tweedlie. This ray not only differs from *U. asterias* in the absence of large, sharp spines on the median line of the back, but also in having more prominent and rougher prickles on the disk. The disk is somewhat less strongly angular, the snout is less prominently produced, the mouth is smaller and the spiracles are placed higher. The species appears to be rare.

Known only from Panama. The specimen at hand is from Chame Point.

41. Urotrygon asterias (Jordan & Gilbert).

Urolophus asterias Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 579 (Mazatlan; Panama); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 82.

Urolophus mundus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 16 (Panama; not of Gill).

Urotrygon mundus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 406, Pl. XXX, figs. 1-2 (In part).

Disk angular, the antero-lateral margins nearly straight, the tip of snout produced, pointed, the lateral and posterior margins rounded, disk broader than long, the wing-like expansions proportionately greater in the adult than in the young, width of disk .85 to .95 in its greatest length; eyes moderate, rather remote, the interspace 2.6 to 2.9 in preocular part of snout; spiracles immediately behind and below orbit, about equal in size to the eye; mouth slightly arched, its width 2.15 to 2.2 in preocular part of snout; teeth in pavement, diamond shaped, without cusps; upper surface of disk and tail everywhere with short prickles and a median row of enlarged spines, extending from head to base of caudal spine; tail about equal to the length of the disk, depressed at base and with a low lateral keel; caudal spine strong, reaching origin of the caudal fin fold; caudal fin rather narrow, ending in a broad point; ventral fins short and broad, with nearly straight posterior margin.

Color grayish above, white below. Our largest specimen with irregular dark spots.

Two female specimens, 132 and 425 mm. in length, with a disk 73 and 244 mm. broad and 69 and 210 mm. long, were secured. Two well developed embryos, a male and a female, were removed from the large specimen. The upper surface of the embryos is perfectly smooth, but the caudal spine is well developed. Our small specimen has the prickles and spines on the upper surface quite prominently developed, but it agrees with the embryos in being uniform grayish in color, without indications of spots. This species has been confused by recent authors with *U. mundus,* the type of which is lost, but the description of *U. mundus* does not mention the presence of a median row of spines on the back, although it is stated that the skin is beset with numerous tubercles which are largest on the back. The presence or absence of a median row of spines on the back was considered either of no specific value or it was supposed that they were present, although not mentioned in the description of the type of *U. mundus.* We, however, are unable to agree with these authors, as we have before us specimens of both forms which we must regard as distinct.

Known from Mazatlan to Panama Bay. Our specimens are from Naos Island and the Panama City fish market.

42. Urotrygon goodei (Jordan & Bollman).

Urolophus goodei Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 151 (Panama Bay); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 81.

Urotrygon goodei Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 405.

This species has been taken in Panama Bay by the Albatross at a depth of 33 fathoms. It was not seen by us. The following description is from Jordan & Evermann (1896):

"Disk broader than long, by a distance equal to snout and ½ eye; front margins of disk slightly convex, the tip of snout exserted and sharply pointed, its length 3¾ in length of disk; eye equal to spiracle, 3¼ in snout; edge of spiracles entire; width of mouth 2 in snout before it; ventrals projecting beyond disk, their length 1¼ in their breadth. Caudal spine large, as long as snout and ½ eye, its edge with 8 to 10 retrorse spinules, its insertion before middle of tail (from axil of pectoral), its tip reaching front of caudal; tail longer than disk by a distance equal to eye and spiracle; skin smooth or somewhat prickly on upper surface of snout; 1 or 2 strong spines

on middle of back. Color plain brown, nearly uniform, the margins bright yellow in life."

Recorded from Panama Bay and Bay of St. Helena near Guayaquil.

43. Urotrygon aspidurus (Jordan & Gilbert).

Urolophus aspidurus Jordan & Gilbert, Bull. U. S. Fish Comm., I, 1881 (1882), 307 (Panama Bay); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 81; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 16 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 80 (Panama Bay).

Urotrygon aspidurus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 405, Pl. LXIX, fig. 3 (skeleton).

Disk somewhat broader than long, angular, the antero-lateral margins nearly straight, the tip of snout usually greatly produced, variable, the lateral and posterior outlines rounded; eyes rather remote, the interspace 2.75 to 3 in preocular part of snout; spiracles elongate, a little larger than eyes and placed immediately behind and below the orbit; mouth arched forward; teeth in pavement, with prominent cusps in the type, a young male, with prominent ridges but no cusp in females, one smaller and also one larger than the type; disk smooth; tail in advance of caudal spine, with 1 to 8 sharp spines, increasing in number with age and entirely undeveloped in very young; tail a little longer than the disk, strongly depressed at base; caudal spine moderate, not quite reaching the beginning of caudal fin fold; caudal fin rather narrow, rounded; ventral fins rather narrow in the male, broader in the female, the outer angle acute, inner angle rounded, the posterior margin nearly straight.

Color uniform brown, the margins of the disk somewhat paler; white underneath.

This species, although reported abundant at Panama by Gilbert & Starks, was not obtained by us. We have examined the type and 2 other specimens from Panama.

Known only from Panama Bay.

19. Genus **Urobatis** Garman.

Urobatis Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 401 (type *Leiobatus sloani* Blainville).

This genus in external characters appears to differ from *Urotrygon* in having a broader caudal fin, which is rayed and rounded posteriorly; tail shorter, not longer than the body; and the broader ventrals which

are directed backward. Garman states that the embryo has no orbital process, which is present in *Urotrygon,* but with a long, slender, pointed post-spiracular process on the spiracular tegmen, which is a short blunt process in *Urotrygon.*

44. Urobatis halleri (Cooper).

Urolophus halleri Cooper, Proc. Cal. Ac. Sci., III, 1863, 95 (San Diego); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 621 (Panama Bay); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 80; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 15.

Urobatis halleri Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 403.

This species has not been taken at Panama by recent investigators, but it was recorded from there by Jordan & Gilbert in 1882. It is described by Jordan & Evermann (1896) as follows:

"Disk nearly round, a little broader than long, with the anterior margins straightish, meeting in a slight angle. Snout (from the eyes) longer than the width of the interorbital space; less than ¼ disk. Tail somewhat shorter than the disk. Teeth obtuse in both sexes. Skin perfectly smooth, without spines or prickles."

Garman (1913) offers the following, concerning color:

"In a lot of more than a hundred examples secured by Professor Louis Agassiz at San Diego, California, there is a considerable amount of individual variation in colors. Most of the specimens are brown with small spots of yellow, very small on some, larger on others, smaller toward the margins, thickly strewn over the entire back and tail or occasionally absent from the middle of the disk. Less numerous, perhaps, are those brown with vermiculations of yellow over the whole back or only in the central portions. Some are more yellow than brown and on some the brown is variously clouded. The back is usually darkest in the middle and on the head; the fins are lighter near and on the margins; the tail is usually not darker."

Known from San Diego, California, to Panama Bay.

20. Genus **Pteroplatea** Müller & Henle.

Pteroplatea Müller & Henle, Stizb. k. Ak. Wiss. Berlin, 1837, 117, and Plagiostomen, 1841, 168 (type *Raia altavela* Linnæus).

Disk much broader than long, its anterior margins meeting at very obtuse angle, its outer angles more or less acute, the form, therefore,

transversely rhombic; skin smooth or very nearly so; tail very short and slender, shorter than the disk, without rayed fin, armed with a small serrated spine which is often wanting.

KEY TO THE SPECIES.

a. Tail with a distinct dermal fold above and a weaker one below. *micrura*, p. 87.

aa. Tail with a slight dermal fold above. *crebripunctata*, p. 87.

45. Pteroplatea micrura (Bloch & Schneider).

Raia micrura Bloch & Schneider, Syst. Ichth., 1801, 360 (Surinam).

Raja maclura Le Sueur, Journ. Ac. Nat. Sci. Phila., I, 1817, 41, with figure (Rhode Island).

Trygon maclura Cuvier, Règne Animal, Ed. II, II, 1829, 400.

Pteroplatea maclura Müller & Henle, Plagiostomen, 1841, 169; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 86.

Pastinaca maclura De Kay, Fauna N. Y., Fishes, 1842, 375, Pl. LXV, fig. 213.

Pteroplatea micrura Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 414.

Disk scarcely twice as broad as long, with a broad angle in front of snout and a slight indentation in front of the middle of each pectoral, outer ends of the pectorals subangular; no tentacles on margin of spiracles; skin perfectly smooth; tail slender, with a distinct fold above and a weaker one below, its length about ⅓ of the length of the disk; caudal spine wanting in young.

Color brownish, punctulate or vermiculate with lighter; tail dark, with 4 or 5 bands or blotches of lighter.

This species was not taken by us and it is not recorded from the Isthmus of Panama, but its range brings it within the scope of the present work.

Known from New York to Brazil.

46. Pteroplatea crebripunctata Peters.

Pteroplatea crebripunctata Peters, Monatsb. k. Ak. Wiss. Berlin, 1869, 703; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 87; Gilbert & Starks, Memoir. Mus. Comp. Zoöl., IV, 1904, 18 (Panama Bay); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 413.

Garman (1913) gives the following account of this species which was not seen by us:

"Snout to abdominal pores half the width of the disk. Tip of snout a slight prominence. Anterior margin of pectoral waved, concave in the middle, outer and hinder angles rounded somewhat broadly. No tentacle on the spiracle. No dorsal fin. Tail less than half the length of the body, with a slight fold above, behind the spine.

"Brown with black puncticulations; yellowish below. Rarely with white spots."

Known from the Gulf of California to Lobas de Afuera, Peru. The Panama record is by Gilbert and Starks (1904).

Family XIV. **Myliobatidæ.**

The Eagle Rays.

Body, head and pectorals forming a very broad disk; the pectorals usually not united, but ceasing on sides of head and reappearing in front of snout as 1 or 2 fleshy protruberances, known as "cephalic fins"; tail very long and slender, whip-like, bearing on the basal portion a small dorsal fin and behind it usually a serrated spine; teeth large, flat, hexangular, the middle ones usually broader than the outer ones; eyes prominent, lateral; spiracles large, behind the eyes; skin smooth. Species ovoviviparous.

KEY TO THE GENERA.

a. Teeth in one row in each jaw, very broad; muzzle entire. *Aëtobatus,* p. 88.

aa. Teeth in more than 3 rows in each jaw.

b. Sides of head not free from the pectoral fins, but extending to snout, forming a single lobe or rostral process. *Myliobatis,* p. 90.

bb. Sides of head free from pectoral fins and not continuous with the rostral process. *Pteromylæus,* p. 91.

21. Genus **Aëtobatus** Blainville.

Aëtobatus Blainville, Bull. Soc. Philom., 1816, 112 (type *Raja narinari* Euphrasen).

Pectoral fins slightly falciform, not continuous; rostral process separated from the pectorals and at a lower level; head prominent, narrowing downward and forward on the sides; snout narrow, produced; teeth in the jaws in a single series, fused, lower curved and

projecting beyond the upper; tail long, slender, bearing a dorsal fin and a serrated spine above the basal portion; ventral fins narrow, elongate.

47. Aëtobatus narinari (Euphrasen).

Narinari brasiliensis Marcgrave, Hist. Nat. Brazil, 1648, 175 (Brazil).

Raja narinari Euphrasen, Handl. k. Sven. Vet.-Akad., XI, 1790, 217, Pl. X (After Marcgrave).

Aëtobatus narinari Blainville, Bull. Soc. Philom., 1816, 112; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 88; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 18; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 441, Pl. XLIX, figs. 1-3 (teeth), Pl. LIV, fig. 4 (pelvis), Pl. LVII, fig. 4 (heart), Pl. LXXIII, fig. 4 (skeleton).

Myliobatis narinari Cuvier, Règne Animal, Ed. I, II, 1817, 138.

Raia quinquemaculata Quoy & Gaimard, Voy. Uranie, Poiss., 1824, 200, Pl. XLIII, fig. 3.

Aëtobatus latirostris Duméril, Arch. Mus. Hist. Nat., X, 1861, 242, Pl. XX, fig. 1 (Western Africa).

Aëtobatus laticeps Gill, Ann. Lyc. Nat. Hist. N. Y., VIII, 1865, 137 (Locality unknown, received from San Francisco); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 88.

Stoasodon narinari Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 879.

Stoasodon laticeps Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 879.

Width of disk nearly twice the length, its anterior borders concave, posterior borders convex, outer angles pointed; rostral process distinct from the pectoral, depressed and pointed; teeth in a single row on each jaw, broad and short, fused, those of the lower jaw flatter and more produced than the upper; spiracles large, lateral, behind the eyes; tail whip-like, very slender, more than 4 times the length of the body; dorsal small, origin above the ends of the bases of the ventrals; ventrals narrow, elongate.

Color brown, with spots of bluish white scattered over the back, fainter on the head and the forward part of the disk, white beneath; tail dark.

This ray is known from the tropical parts of the Atlantic and the eastern Pacific. It was taken in Panama Bay in 1896 by Dr. Gilbert and associates who report that it was frequently seen. The species was not observed by us.

22. Genus **Myliobatis** Cuvier.

Myliobatis Cuvier, Règne Animal, Ed. I, II, 1817, 137 (type *Raja aquila* Linnæus).

Disk broad, the outer angles acute; the pectoral fins continued along side of head to end of snout, forming a single lobe; tail very long and slender; nasal valves confluent in a broad flap with free margin in front of mouth; teeth in 7 rows, the median ones broad, the lateral ones narrower; dorsal fin small, placed over or a little behind the ventrals; a serrated spine on base of tail behind the dorsal fin; ventral fins short and broad.

KEY TO THE SPECIES.

a. Snout short, broadly rounded; tips of pectorals of moderate width, blunt; origin of dorsal 3 lengths of its base behind bases of ventrals. *goodei*, p. 90.

aa. Snout elongate, pointed; tips of pectorals narrow, pointed; origin of dorsal 1.5 times the length of its base behind bases of ventrals. *freminvillii*, p. 91.

48. **Myliobatis goodei** Garman.

Myliobatis goodei Garman, Proc. U. S. Nat. Mus., 1885, 39 (Central America); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2755; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 430.

This species is not recorded from the Isthmus of Panama, but its range of distribution appears to bring it within the scope of the present work. It is described as follows by Garman (1913):

"Disk less than twice as broad as long, outer angles rather widely rounded, anterior border very little convex, hinder concave in its outer half, convex in the inner, posterior angle blunt. Head of little prominence; fontanel broad on the forehead, narrowing abruptly then tapering gradually, or nearly parallel, rounded behind. Rays of rostral fins at sides of head nearly as long as those in front of the snout, making a broad flange connecting rostrals and pectorals. Teeth in the median series three to four times as wide as long, the third row is about two thirds, and the second half as wide as the median, while the teeth in the outer row are as broad as long. Eyes very small; no horn above the orbit. Spiracle more than three times the length of the eye. Dorsal small, rounded above, fin not extended behind the base, distant from the bases of the ventrals three times its length, in front of a serrated spine. Ventrals short, broader than long, angles rounded,

hind margin slightly convex. Pectorals little wider than long, not falciform. Narial flap short, broad, little blunted at the angles, fringed at the teeth. Tail more than one and two thirds times the length of the disk.

"Back brown; white below."

Recorded from "Central America" and the Rio Grande do Sul, Brazil.

49. Myliobatis freminvillii Le Sueur.

Myliobatis freminvillii Le Sueur, Journ. Ac. Nat. Sci. Phila., IV, 1824, 111 (Rhode Island); Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 432, Pls. XXXV, XXXIX, fig. 2 and LIV, fig. 3.

Myliobatis bispinosus Storer, Proc. Bost. Soc. Nat. Hist., I, 1842, 53 (Massachusetts).

Myliobatis acuta Ayers, Proc. Bost. Soc. Nat. Hist., I, 1842, 65 (Connecticut).

Myliobatis freminvillei Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 89.

Width of disk less than twice its length; snout tapering, rather pointed; rostral processes connected at the side of the head with the pectorals by rays as long as eye; teeth in 7 rows, those in the main rows 4 to 6 times as broad as long, those in the outer 3 rows as wide as long; skin smooth or nearly so; a horn-like protuberance above each eye of the male; tail slender, more than 2 times the body from snout to vent; a serrated spine behind dorsal fin; dorsal fin moderate, its origin 1.5 times the length of its base behind bases of ventrals; ventral fins as broad as long.

Color brownish above; whitish below.

Known from Cape Cod to Brazil. Not as yet recorded from the coast of Panama.

23. Genus **Pteromylæus** Garman.

Pteromylæus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 437 (type *Myliobatis asperrimus* Gilbert).

"This genus resembles *Aëtobatus* somewhat closely in general appearance and in structure but differs greatly in dentition. Compared with *Myliobatis* the head is more elongate, and more narrow forward and in the snout, the pectoral fins are more falciform and are not continuous with the rostral fins at the side of the head, the ventrals are more elongate and narrow and the spiracles are open more upward

and less to the side. The teeth are tessellate, in seven rows; a median row of very broad teeth at each side of which are three very narrow ones. The tail is long and slender; it bears a serrated spine behind the dorsal." (Garman.)

50. Pteromylæus asperrimus (Gilbert).

Myliobatis asperrimus Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2754 (Panama Bay); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 19, Pl. III, fig. 6 (Panama Bay).

Pteromylæus asperrimus Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 438.

Disk nearly twice as broad as long, anterior margins convex, posterior margins concave, outer angles slightly blunted; head prominent; snout produced, pointed; rostral process not continuous with the pectoral fins, narrower and at a lower level than the cranium, forming a flexible lobe; spiracles large, twice the length of eye; tail slender, very long, more than 3 times the length of body; caudal spine present; skin rough with small spines on upper parts, lower surface smooth except at base of pectorals, and other patches on lower side of head, belly and base of ventrals; dorsal small, as long as the spiracle, its origin about 2 times the length of its base back of the bases of the ventrals; ventral fins moderate, longer than broad, rounded posteriorly, reaching considerably behind margin of pectorals.

Color dusky brown above, the anterior portion of the pectorals with 8 to 10 narrow transverse bars of bluish white, most of which break up into series of spots toward middle line, which are irregular in size and shape, as large as the eye to very small. Sometimes the edges of snout, disk, dorsal and the tail are black.

This species is known only from Panama Bay where the type was secured by Dr. Gilbert and associates in 1896. It was not seen by us.

Family XV. **Mobulidæ.**

The Sea Devils.

Head, body and pectorals forming a subrhomboid disk, broader than long; head broad and flat, bearing cephalic fins or processes, developed as 2 long, horn-like appendages, separate from the pectorals; mouth large, transverse, terminal or inferior; teeth small, numerous, in pavement; tail long, whip-like, with a single dorsal fin at its base, and with or without a serrated spine; eyes lateral; skin more or less

rough; a single dorsal fin present on base of tail; ventrals small, between the pectorals.

Some of the members of this family reach an enormous size. It is said that individuals have been taken which were 20 feet wide and weighed more than 4 tons.

KEY TO THE GENERA.

a.	Mouth inferior; teeth on both jaws.	*Mobula*, p. 93.
aa.	Mouth anterior; teeth on lower jaw only.	*Manta*, p. 94.

24. Genus **Mobula** Rafinesque.

Mobula Rafinesque, Ind. d'Itt. Sicil., etc., 1810, 48 & 61 (type *Mobula auriculata* Rafinesque).

Head broad, flat, truncate; internarial space wide; mouth wide, inferior; rostral appendages moderate, directed forward and obliquely downward, rolled from below outward in a subcylindrical roll when not in use; teeth on both jaws small, numerous, in pavement.

51. Mobula hypostoma (Bancroft).

Cephalopterus hypostomus Bancroft, Proc. Zoöl. Soc. London, 1831, 134 (Jamaica).

Cephaloptera olfersii Müller, Abh. k. Ak. Wiss. Berlin, 1834, 311 (Brazil).

Dicerobatis olfersii Günther, Cat. Fish. Brit. Mus., VIII, 1870, 497.

Aodon hypostomus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 92.

Mobula olfersi Coles, Bull. Amer. Mus. Nat. Hist., XXVIII, 1910, 341.

Mobula hypostoma Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 453, Pl. XXXVIII, Pl. LIV, fig. 6 (pelvis), Pl. LVII, fig. 6 (heart), LIX, figs. 7 & 8 (gills), Pl. LXXV (skeleton).

Disk irregularly diamond-shaped, nearly 2 times as broad as long, the anterior margins nearly straight, the posterior ones concave, the angles acute; teeth small, broad, rounded or with one or several points on the inward edge, increasing in number and in width of band with age; back smooth except in large individuals which are rough posteriorly on the body and on the tail; origin of the dorsal fin little behind vent.

Color brown on back; white underneath.

Known from New York to Brazil. It is not as yet recorded from the Panama coast and it was not seen by us.

25. Genus **Manta** Bancroft.

Manta Bancroft, Zoöl. Journ., IV, 1829, 454 (type *Manta americana* Bancroft = *Raja birostris* Walbaum).

Disk broader than long, its exterior angles acute, the posterior margins concave; head broad, flat, truncate; cephalic processes long, turned forward and inward; mouth very wide, terminal; teeth on lower jaw only, very small, in numerous rows; skin rough, with small tubercles; tail long, whip-like; a small dorsal fin over the ventrals.

52. **Manta birostris** (Walbaum).

Raja birostris Walbaum, Artedi Piscium, 1792, 535.

Raia manatia Bloch & Schneider, Syst. Ichth., 1801, 364 (Tropical America).

Raja fimbriata Lacépède, Hist. Nat. Poiss., IV, 1802, 677, Pl. XVI, fig. 3 (Gulf Stream 58° N.).

Cephalopterus vampyrus Mitchill, Ann. Lyc. Nat. Hist. N. Y., I, 1824, 23, Pl. II, fig. 1 (Delaware Bay).

Cephaloptera giorna Le Sueur, Journ. Ac. Nat. Sci. Phila., IV, 1824, 115, Pl. VI (Georgia).

Cephalopterus manta Bancroft, Zoöl. Journ., IV, 1829, 453 (Jamaica).

Manta americana Bancroft, Zöol. Journ., IV, 1829, 454 (Jamaica).

Ceratoptera johnii Müller & Henle, Plagiostomen, 1841, 186, Pl. LIX (West Indies).

Brachioptilon hamiltoni Newman, Zoölogist, 1849, 74 (Gulf of California).

Diabolichthys elliotti Holmes, Proc. Elliott Soc. Nat. Hist., 1856, 39 (Charleston).

Ceratoptera vampirus Duméril, Elasmobranches, I, 1865, 660.

Ceratoptera vampyrus Günther, Cat. Fish. Brit. Mus., VIII, 1870, 498.

Manta birostris Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 52; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 92, Pl. XVIII, fig. 39; Garman, Memoir. Mus. Comp. Zoöl., XXXVI, 1913, 454.

Disk nearly 2 times as broad as long; tail about as long as disk including rostral processes; teeth minute, rasp-like, on the lower jaw only, occupying the entire width of the jaw, in numerous rows; skin of body and tail everywhere rough with small tubercles; origin of dorsal a little forward of the ends of the bases of the pectorals; ventral fins small, posterior margin rounded, not reaching to the ends of the pectorals.

Color dark brown, becoming darker with age; white underneath.

Known from both coasts of America, but apparently it is not recorded from either coast of Panama, although doubtless it occurs there. The species was not seen by us.

Class III. Teleostomi.

Order V. Nematognathi.

Family XVI. Siluridæ.

The Catfishes.

Body elongate, rather low and broad; head with 2 or more barbels, the longest pair being attached to the rudimentary maxillaries; anterior margin of the upper jaw formed by the premaxillaries only; preopercle obsolete; opercle large; no normal scales, the body naked or with bony plates; dorsal fin usually present, short; the anterior ray of dorsal and pectorals each usually spiny; adipose fin usually present.

This is a very large family of fishes. The forms treated of in this work may be readily recognized by the naked body, the presence of 2 or 3 pairs of barbels and by the presence of an adipose fin.

Only two species were taken on the Atlantic coast of Panama, but the forms are numerous and difficult to separate on the Pacific coast. It is possible that too many species have been recognized in this work. Time would, however, not permit us to reexamine many specimens, taken by previous investigators, in connection with our large collection, as we should like to have done, and which would have been most interesting and helpful. Nearly all of the members of the family discussed in the present work are used as food, and on the Pacific coast they form a very important food supply, as many of them occur in abundance and reach a rather large size.

key to the genera.

a. Lower jaw with a single pair of barbels; maxillary barbel compressed, band-shaped. *Felichthys*, p. 96.

aa. Lower jaw with two pairs of barbels; maxillary barbel not band-shaped.

b. A transverse membranous fold, with a free edge, on snout, connecting the posterior nostrils. *Selenaspis*, p. 101.

bb. No transverse membranous fold on snout as above.

c. Dorsal shield enlarged, usually as long as or longer than broad, pointed anteriorly and fitting into the emarginate occipital process. *Sciadeichthys*, p. 103.

cc. Dorsal shield not enlarged, crescent-shaped, its length on median line much less than its width.

d. Gill-rakers in small or moderate numbers, usually 13 or fewer on lower limb of first arch.

e. Teeth all pointed, or those on vomer and palatines slightly bluntish; the palatine teeth in small or moderate patches, not produced backward on pterygoids. *Galeichthys*, p. 104.

ee. Teeth on the jaws pointed or slightly bluntish; vomerine and palatine teeth more or less bluntish; the palatine teeth in large patches with backward projection, extending on the pterygoids. *Netuma*, p. 112

eee. Teeth on upper jaw pointed; posterior teeth near symphysis on lower jaw blunt, the others pointed; vomerine teeth wanting; palatine teeth granular, in small or moderate patches, without backward projection. *Arius*, p. 122.

dd. Gill-rakers in rather large numbers, not fewer than 30 on lower limb of first arch; eye placed low, partly below level of mouth. *Cathorops*, p. 129.

26. Genus **Felichthys** Swainson.

Breviceps Swainson, Nat. Hist. & Class. Fish., I, 1838, 328 (type *Breviceps filamentosus* Swainson = *Arius bahiensis* Castelnau; name preoccupied).

Felichthys Swainson, Nat. Hist. & Class. Fish., II, 1839, 305 (type *Felichthys filamentosus* Swainson; substitute for *Breviceps*).

Ailurichthys Baird & Girard, Proc. Ac. Nat. Sci. Phila., 1854, 26 (type *Silurus marinus* Mitchill).

Ælurichthys Gill, Proc. Ac. Nat. Sci. Phila., 1863, 172 (Corrected spelling).

Body elongate, little, if at all, compressed; head depressed; snout very broad, projecting; mouth large; teeth all villiform, in more or less distinct bands on jaws, vomer and palatines; a large fontanel; barbels 4, maxillary barbel long, broad, band-like; pectoral spines and usually the dorsal spine with a long band-like filament; caudal fin deeply forked; anal fin more or less emarginate.

The species of this genus are seldom caught with seines at Panama. They appear to inhabit mostly the coral reefs and rocky bottom. They are also common around wharf piers. Our specimens were nearly all taken either with hook and line or by use of dynamite.

KEY TO THE SPECIES.

a. Dorsal spine not produced in a long filament; gill-rakers about 12. *panamensis*, p. 97.

aa. Dorsal spine produced in a long filament; gill-rakers fewer than 12.

b. Distance from tip of snout to origin of dorsal 2.95 to 3.1 in length; anal fin with 19 to 23 rays, without a large black blotch. *felis*, p. 99.

bb. Distance from tip of snout to origin of dorsal 3.5 to 3.8 in length; anal fin with 29 to 32 rays, its anterior part with a large black blotch. *pinnimaculatus*, p. 100.

53. Felichthys panamensis (Gill).

Ælurichthys panamensis Gill, Proc. Ac. Nat. Sci. Phila., 1863, 172 (West coast Central America); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 14, Pl. II, figs. 1-4 (Altata; Panama; Magdelena Bay); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 622 (Panama).

Ælurichthys nuchalis Günther, Cat. Fish. Brit. Mus., V, 1864, 179, and Trans. Zoöl. Soc. London, VI, 1868, 476, Pl. LXXXI, fig. 2 (Panama).

Felichthys panamensis Gilbert & Starks, Memoir. Cal. Ac. Sci,. IV, 1904, 20 (Panama Bay).

Ælurichthys scutatus Regan, Biol. Cent. Amer., Pisc., 1907, 116, Pl. XV, fig. 2 and Pl. XIX, fig. 2 (Pacific coast, Panama; N. W. Ecuador). (Female)

Ælurichthys isthmensis Regan, Biol. Cent. Amer., Pisc., 1907, 117, Pl. XV, fig. 1 and Pl. XIX, fig. 1 (Atlantic coast, Panama; Colon?). (Male)

Head 3.55 to 3.95; depth 4.15 to 4.6; D. I, 7; A. 27 to 30.

Body robust, the depth at origin of dorsal scarcely greater than the width; tail tapering, compressed; anterior profile straight over head, convex at nape; head rather low; snout broad, depressed, moderately projecting, 3.4 to 3.8 in head; eye 4.6 to 5.3; mouth broad, the gape reaching under anterior margin of eye; teeth in villiform bands, the upper jaw with a crescent-shaped band, more or less constricted in the middle, ending in a blunt point laterally, band on lower jaw narrower, interrupted at symphysis, vomerine teeth narrowly separated from the palatine, with a constriction in middle, palatine patches of teeth narrower than the vomerine; 2 pairs of barbels, the maxillary barbel flat, ribbon-shaped, often reaching nearly to base of

ventrals, the mandibular barbels short, flat, reaching nearly or quite to margin of gill-covers; gill-rakers about 12; distance from tip of snout to origin of dorsal 2.8 to 3.1 in length; dorsal spine 1.4 to 1.6 in head, without a filament; adipose fin moderate, inserted over posterior third of anal; caudal fin deeply forked, the upper lobe the longest; anal fin anteriorly high in the females, not greatly elevated in males, its base 1.2 to 1.45 in head; ventral fins long in females, reaching past origin of anal, shorter in males, failing to reach anal, inserted about equidistant from base of pectorals and middle of base of anal; pectoral fins moderate, the spine 1.25 to 1.4 in head, its filament usually reaching to or beyond origin of anal.

Color steel-blue above; silvery below; sides often with a yellowish lustre and usually with dusky punctulations; dorsal fin greenish or dusky, the other fins pale with a varying amount of dusky.

This catfish is represented by 17 specimens, ranging in length from 300 to 380 mm. It is a common food fish and may be seen in the Panama City market almost daily. The sexual differences are pronounced and are well described by Gilbert & Starks (1904) thus: "The specimens do not differ according to sex in the shape of the dorsal buckler as extensively as is indicated in Steindachner's figures. Furthermore, such difference as exists is in the opposite direction to that observed by him, as the buckler is larger and proportionately somewhat wider in the females than in the males. More obvious sexual differences are found in the length of the ventral fins and in the shape of the anal. In females the ventrals are long, constantly extending beyond the front of the anal. In males they fail to reach the front of the anal fin. In females the anterior portion of the anal fin is produced, forming a projecting lobe, thus giving a strongly concave arch to the posterior half of the margin of the fin. In males there is no lobe, and the margin of the fin is nearly or wholly straight. * * * Another sexual difference seems to exist in the size of the head, which in the present specimens is less in the case of the females, 3 5/7 to 3⅞ (3⅗ in males)." We are including in the synonomy Regan's *Ælurichthys isthmensis* which he bases on specimens from Colon. His description suits the male of the present species admirably, and it seems probable to us that his specimens were from the Pacific coast instead of the Atlantic. Such a mistake could come about very easily, as the fish are constantly shipped from the Pacific coast to the Colon market.

Known from Mazatlan to Guayaquil. Our specimens are from Chame Point and Panama.

54. Felichthys felis (Linnæus).

Silurus felis Linnæus, Syst. Nat., Ed. XII, 1766, 503 (Charleston, S. C.).

Silurus marinus Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 433 (New York).

Galeichthys marinus DeKay, Fauna N. Y., Fishes, 1842, 178, Pl. XXXVII, fig. 118.

Ailurichthys marinus Baird & Girard, Proc. Ac. Nat. Sci. Phila., 1854, 26.

Ælurichthys marinus Günther, Cat. Fish. Brit. Mus., V, 1864, 178.

Felichthys marinus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 118.

Felichthys felis Smith, N. C. Geol. & Econ. Surv., II, 1907, 62, fig. 15.

Head 3.55 to 3.8; depth 4.05 to 4.5; D. I, 7; A. 19 to 23.

Body rather robust, its greatest depth a little greater than width, tapering posteriorly but not much compressed; profile from tip of snout to origin of dorsal straight; head depressed, broad; snout short and broad, not much longer than eye; eye 4.6 to 5.1 in head; mouth broad, cleft nearly or quite to anterior margin of eye; teeth small, in villiform bands on jaws, vomer and palatines, the band on upper jaw continuous, narrowest in middle, the band on lower jaw interrupted at symphysis, tapering posteriorly, vomerine and palatine band variable, united and forming a crescent-shaped band, or divided into patches, the palatine teeth being separate from the vomer and the vomerine patch divided at middle (Most specimens at hand have the vomerine patch interrupted on the median line, but continuous with the palatine teeth.); 2 pairs of barbels present, the maxillary barbel flattened, ribbon-shaped, reaching from base of ventrals to opposite anal base, mandibular barbels small, failing to reach margin of gill-covers; gill-rakers about 5; distance from tip of snout to origin of dorsal 2.95 to 3.1 in length; dorsal spine 1.1 to 1.4 in head, its filament reaching to or beyond adipose fin; adipose fin moderate, inserted a little in advance of middle of base of anal; caudal fin deeply forked, the upper lobe longest; anal fin anteriorly elevated, its base 1.5 to 1.7 in head; ventral fins moderate, inserted a little nearer base of pectorals than base of last rays of anal; pectoral fins moderate, the spine 1.1 to 1.3 in head, its filament usually reaching opposite anal base.

Color uniform steel-blue above; silvery below, with or without dark points; dorsal fin with more or less dusky anteriorly, usually mostly yellowish green; adipose dusky; caudal with upper lobe more

or less dusky, the lower lobe yellowish green; the other fins pale or with or without dusky punctulations.

We preserved 16 specimens, ranging in length from 160 to 370 mm., of this common food fish. It is rarely captured with seines, but it takes the hook readily and it may also be taken with dynamite on the coral reefs at Colon. We compared our specimens with others from North Carolina, South Carolina, Yucatan and Nicaragua and found them all identical. We regard *F. bahiensis* (Castelnau) as doubtfully distinct. The sexual differences are identical with those described for *F. panamensis* but are scarcely so strongly marked.

Known from Cape Cod to Panama. Our specimens are from Toro Point, Mindi Reef, Cristobal and Colon.

55. Felichthys pinnimaculatus (Steindachner).

Ælurichthys pinnimaculatus Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 15, Pl. VIII, figs. 1-3 (Panama; Altata; West coast of Costa Rica); Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 34, and Proc. U. S. Nat. Mus., 1882, 622 (Panama); Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Rio Tuyra, Darien).

Ailurichthys pinnimaculatus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 148 (Panama).

Felichthys pinnimaculatus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 117; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 20 (Panama Bay).

Head 4.15 to 4.5; depth 4.9 to 5.4; D. I, 7; A. 29 to 32.

Body anteriorly as broad as deep, posteriorly compressed; profile from snout to dorsal straight or slightly concave; head depressed, notably broader than deep; snout very broad, projecting moderately beyond lower jaw, 4.1 to 4.9 in head; eye lateral, 4.75 to 6.2 in head; mouth broad, the cleft reaching under anterior margin of eye; teeth small, pointed, in bands, the band on upper jaw continuous, slightly narrowed in the middle, band on lower jaw interrupted at symphysis and tapering at angle of mouth, vomer and palatines with a continuous, crescent-shaped band of about equal width throughout; 2 pairs of barbels present; maxillary barbels broad, band-shaped, reaching to or past middle of base of anal; mandibular barbels short, flat, scarcely reaching margin of gill-membranes; gill-rakers about 3; distance from tip of snout to origin of dorsal 3.5 to 3.8 in length; dorsal spine 1.2 to 1.45 in head, its filament reaching base of caudal; adipose fin large,

inserted over middle of base of anal; caudal fin deeply forked, the upper lobe longest; anal fin long, elevated anteriorly, its base 3.95 to 4.35 in head; ventral fins moderate, usually reaching about to origin of anal, inserted a little nearer origin of anal than base of pectorals; pectoral fins moderate, the spine 1.2 to 1.4 in head, its filament reaching opposite or beyond anal base.

Color steel-blue above; lower parts silvery, with or without dark points; dorsal fin yellowish green, the spine and often the base of fin dark; adipose fin dark; base of caudal and upper lobe more or less clouded, the lower lobe yellowish green; the other fins mostly pale, the anal with a large black area in front.

This well marked species is represented by 10 specimens, ranging in length from 315 to 470 mm. This is an important food fish at Panama. The sexual differences are not well marked.

Known from Sinaloa, Mexico, to Guayaquil, Ecuador. Our specimens are from Balboa and Panama City.

27. Genus **Selenaspis** Bleeker.

Selenaspis Bleeker, Ichth. Archi. Indici, Siluri, I, 1858, 62 (type *Silurius herzbergi* Bloch).

This genus is readily distinguished from related genera by the transverse membranous folds on the snout, connecting the posterior nostrils.

A single species occurs on the Pacific coast of Panama.

56. Selenaspis dowii (Gill).

Leptarius dowii Gill, Proc. Ac. Nat. Sci. Phila., 1863, 171 (Panama).

Arius alatus Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 19, Pl. VI (Panama); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 621 (Panama).

Arius dowi Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 50 (Panama).

Tachisurus dowi Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 142; and Occ. Pap. Cal. Ac. Sci., 1890, 61 (Panama).

Arius dovii Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Rio Sabana, Darien).

Selenaspis dowi Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 26 (Panama Bay).

Galeichthys dovii Regan, Biol. Cent. Amer., Pisc., 1907, 120.

Head 3.3 to 4; depth 6.6 to 9; D. I, 7; A. 19 to 21.

Body very low and broad, the depth not more than three-fourths of the width at origin of dorsal; head much depressed; snout very broadly rounded, strongly projecting, 3.4 to 3.8 in head; eye very small, anteriorly placed, its posterior margin about two-thirds as far from tip of snout as from upper angle of gill-opening, the diameter 8 to 12 in head; interorbital 2.4 to 2.8; mouth very broad, its angle under posterior nostril; teeth on the jaws all pointed; the band on upper jaw broad, continuous, its width a little less than 4 in its length; the band on lower jaw divided at symphysis, tapering to a point posteriorly and nowhere half as broad as the band on upper jaw; vomerine and palatine teeth bluntish; vomerine patches small and separated from each other and from the palatine teeth in our smaller examples, completely united in our largest specimen, and comparatively larger; palatine-pterygoid patches broad anteriorly, with a long pointed projection posteriorly (Our largest specimen in addition to the teeth just described has 2 very large patches posterior to the palatine-pterygoid teeth, these posteriorly united.); maxillary barbel long, reaching beyond tip of pectoral spine in young examples, about to middle of pectoral in adult (640 mm.); gill-rakers 16 to 17; distance from tip of snout to origin of dorsal 2.6 to 3 in length; upper surface of head granular, very rough in adult, less so in young; dorsal shield rather large, about twice as broad as long on median line; occipital process short and very broad, posteriorly as broad as dorsal shield, with a rather sharp median keel; a very shallow frontal depression, no groove; interorbital area roughly granular in adult, nearly smooth in young; dorsal spine 1.8 to 2.4 in head; adipose fin rather long, its base 2.5 to 3.1 in head; caudal fin forked, the upper lobe longest; anal fin moderate, more or less elevated anteriorly, the outer margin concave, at least in female, its base 1.4 to 2.2 in head; ventral fins much longer in female than in male, inserted about midway between base of pectoral spine and middle of base of anal; pectoral spine strong, 1.6 to 1.95 in head.

Color brownish above; pale underneath; dorsal and caudal dusky; the other fins sometimes pale, sometimes mostly black.

This species is represented by 5 specimens, ranging in length from 210 to 885 mm. It is not as abundant as several of the other species of catfishes occurring on the Pacific coast of Panama, but it reaches a larger size. It ascends streams and is often taken in brackish water. It takes the hook quite readily and is able to offer strong resistance. It is used as a food and is not infrequently seen in the market.

Known from Panama to Ecuador. Our specimens are from Balboa, Corozal and the Panama City market.

28. Genus **Sciadeichthys** Bleeker.

Sciadeichthys Bleeker, Act. Soc. Sci. Indo-Neerl., V, 1858, 99 (type *Sciades pictus* Müller & Troschel).

This genus differs from related genera in the enlarged dorsal shield, which is as long as or longer than broad and more or less distinctly pointed anteriorly, fitting into the emarginate occipital shield.

A single species occurs on the Pacific coast of Panama.

57. Sciadeichthys troschelii (Gill).

Sciades troschelii Gill, Proc. Ac. Nat. Sci. Phila., 1863, 171 (Panama).

Arius troschelii Günther, Cat. Fish. Brit. Mus., V, 1864, 150.

Arius brandtii Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 21, Pl. III (Altata; Panama); Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 37-39 (Mazatlan; Punta Arenas; Panama).

Tachisurus brandtii Eigenmann & Eigenmann, Occ. Pap. Cal. Ac. Sci., 1890, 55 (Panama).

Sciadeichthys troscheli Gilbert & Starks, Memoir, Cal. Ac. Sci., IV, 1904, 26 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 83 (Panama Bay).

Galeichthys troscheli Regan, Biol. Cent. Amer., Pisc., 1907, 120. (Mazatlan; Panama).

Head 3.3 to 3.6; depth 4.6 to 5.5; D. I, 7; A. 17 or 18.

Body rather low and broad, the depth usually a little less than the width at origin of dorsal; head moderate, somewhat depressed; snout rather long, broadly rounded, rather strongly projecting, its length 2.8 to 3 in head; eye small, its posterior margin rather nearer upper angle of gill-opening than tip of snout, 5.65 to 8.5 in head; interorbital 2 to 2.3; mouth broad, its angle under posterior nostril; teeth on the jaws all pointed; the band on upper jaw continuous, its greatest width scarcely one-fourth of its length; the band on lower jaw less than half as wide, well separated at symphysis, tapering to a point posteriorly, reaching a little beyond angle of mouth; vomerine and palatine teeth bluntish; the vomerine patches varying in size, sometimes not larger than pupil, sometimes much larger and elongate, separated or not on median line, separated from the palatine-pterygoid patches by a line; the palatine-pterygoid patches triangular, tapering rather abruptly posteriorly; maxillary barbel usually reaching a little beyond base of pectoral spine; gill-rakers 7 or 8; distance from tip of snout to origin or dorsal 2.45 to 2.6 in body; upper surface of head granular, much rougher in some specimens than others; differing from all related

species in the enlarged dorsal shield which usually is sharply pointed anteriorly, but sometimes bluntly pointed and rarely only convex, separated from the occipital shield by a narrow line in the young, coössified with the latter in adult; its posterior margin concave, the sides slightly convex, its greatest width about equal to its length on median line, usually but not always with a sharp keel; occipital process short, notably broader than long, its posterior margin usually deeply concave or deeply emarginate, receiving the point of the dorsal shield, with a sharp median keel in young; frontal depression broad, not reaching occipital process but extending forward on snout, no groove; interorbital area usually with a few granular ridges, the granules sometimes wanting; dorsal spine 1.2 to 1.5 in head; adipose fin moderate, its base 2.4 to 3 in head; caudal fin forked, the upper lobe pointed and the longer; anal fin rather small, anteriorly somewhat elevated, the outer margin slightly concave, its base 2 to 2.25 in head; ventral fins moderate, longer in the female than in the male, as usual among catfishes, inserted about equidistant from the base of the dorsal spine and base of last anal rays; pectoral spine large, 1.25 to 1.35 in head.

Color very dark brownish above, lower parts pale with few or many brown points; fins all dark or dusky, the paired fins and the anal often mostly black.

There are 23 specimens of this species in the Panama collection, ranging in length from 170 to 445 mm. It is a food fish of importance.

Known from Mazatlan to Guayaquil, Ecuador. Our specimens are from Chame Point, Balboa and Panama City market.

29. Genus **Galeichthys** Cuvier & Valenciennes.

Galeichthys Cuvier & Valenciennes, Hist. Nat. Poiss., XV, 1840, 28 (type *Galeichthys feliceps* Cuvier & Valenciennes).

This genus is characterized by the pointed teeth, present on jaws, vomer and palatines. The palatine teeth are in small or moderate patches and do not have a backward extension. The head is rather smooth, usually mostly covered with skin, the granules not prominent.

KEY TO THE SPECIES.

a. Anal fin short, with about 14 rays; sides with a rufous band. *peruvianus*, p. 105.

aa. Anal fin with 16 or more rays; sides without band.

b. Fontanel groove prominent, produced backward nearly or quite to occipital process.

c. Interorbital area with 2 or 4 rather prominent ridges; occipital process narrow posteriorly; anal fin with 19 to 22 rays; gill-rakers on lower limb of first arch 6 or 7.
dasycephalus, p. 106.

cc. Interorbital area without ridges; occipital process rather broad; anal fin with 16 to 19 rays; gill-rakers 10 or 11.

d. Head rather roughly granular; the median keel on occipital process low and blunt; snout very low, tapering; eye small, 6.5 to 7.3 in head in specimens ranging in length from 280 to 350 mm. *seemanni*, p. 107.

dd. Head smooth or only slightly granular; the median keel on occipital process sharp; snout deeper and broader; eye larger, 5.1 to 6.1 in head in specimens ranging from 45 to 345 mm. *jordani*, p. 109.

bb. Fontanel groove undeveloped, appearing as a depression or as a small elongate pit.

e. Anal fin with 17 to 19 rays; gill-rakers 11.
guatemalensis, p. 110.

ee. Anal fin with 22 to 24 rays; gill-rakers 5. *lentiginosus*, p. 111.

58. Galeichthys peruvianus Lütken.

Galeichthys peruvianus Lütken, Vidensk. Meddel. Nat. Foren. Kjøben., 1874, 205 (Callao, Peru); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 34 (Callao, Panama and Altata); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 122, and 1898, 2771; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 21.

Tachyiurus peruvianus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 140, and Occ. Pap. Cal. Ac. Sci., 1890, 51 (Callao, Peru).

"Head 3.28 in length; depth about 5; eye 7 in head, 4 in interocular; snout 3.1 to 3.2; width of head 1.45; D. I, 7; A. 14.

"Body elongate, tapering, caudal peduncle slender, its least depth 4 in head; head rounded, not much depressed; interorbital rounded; snout broad, rather bluntly rounded; top of head smooth, with traces of a few small granulations; fontanel rather deep, barely reaching anteriorly to above posterior margin of eye; top and sides of head with traces of reticulating mucous channels; maxillary barbels not reaching to base of pectorals; mental barbels not reaching gill-opening; post-mental barbels reaching to or beyond gill-opening (barbels quite variable in length). A broad band of villiform teeth on maxillaries;

two small patches of villiform teeth on vomer; patches on palatines wider anteriorly, tapering posteriorly; distance from insertion of dorsal to adipose fin 2.75 in length; caudal deeply forked; ventrals small, 2.04 in head; pectorals 1.55.

"Color in alcohol, back and sides bluish black; lower parts white; a rufous band as wide as eye along lateral line; fins blackish." (Evermann & Radcliffe, Bull. U. S. Nat. Mus., XCV, 1917, p. 31.) Based on specimens from Peru.

This species was not seen by us. It appears to be a rare species, readily separated from related species by the short anal fin and the rufous band on side.

Known from Altata, Mexico, to Callao, Peru. Recorded from Panama by Steindachner and by Gilbert.

59. Galeichthys dasycephalus (Günther).

Arius dasycephalus Günther, Cat. Fish. Brit. Mus., V, 1864, 157 (Sandwich Islands, locality probably wrong); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 26 (Panama); Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 51, and Proc. U. S. Nat. Mus., 1882, 622 (Panama).

Tachisurus dasycephalus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 143, and Occ. Pap. Cal. Ac. Sci., 1890, 82 (Panama).

Tachisurus longicephalus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 143, and Occ. Pap. Cal. Ac. Sci., 1890, 82 (Panama).

Galeichthys dasycephalus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 25 (Panama).

Galeichthys longicephalus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 25 (Panama); Regan, Biol. Cent. Amer., Pisc., 1907, 125 (Panama).

Head 3.8 to 4; depth 4.3 to 5; D. I, 7; A. 19 to 22.

Body elongate, rather slender, the depth at origin of dorsal somewhat greater than the width; head rather small, notably lower and broader in male than in female; snout not very broad, projecting beyond lower jaw; eye rather small, 4.9 to 5.4 in head; interorbital 1.9 to 2; mouth broad, the cleft almost wholly transverse, reaching below posterior nostril; teeth villiform; those on upper jaw in a broad continuous band; the band on lower jaw narrower, interrupted at symphysis, extending a little beyond angle of mouth; vomerine teeth in 2 small patches, or rarely continuous, continuous with or

slightly constricted from the slightly larger palatine patches; maxillary barbel extending to or somewhat beyond base of pectoral; gill-rakers 6 or 7; distance from tip of snout to origin of dorsal 2.7 to 2.85 in head; the upper surface of head and nape variable, rough in the female with pronounced bony tubercles, forming 2 parallel ridges on snout, on the outside of these 2 lower, diverging, ridges; the upper surface of head much smoother in the male, almost completely covered with skin, with or without very low tubercles; fontanel produced as a deep groove; the occipital process narrow posteriorly; dorsal spine 1.4 to 1.65 in head; adipose fin large, inserted over the beginning of the second third of base of anal, its base 2 to 2.3 in head; caudal fin forked, the lobes not much produced, the upper the longer; anal fin anteriorly moderately elevated in female, but not in the male, its base 1.4 to 1.55 in head; ventral fins long in female, reaching to or beyond origin of anal, scarcely reaching anal in male, inserted about equidistant from base of pectorals and middle of base of anal; pectoral fins rather small, the spine 1.25 to 1.65 in head.

Color dark brown; lower parts paler with a silvery luster; the fins yellowish green, pale or dusky; the anal, ventrals and pectorals often dusky or black.

There are 28 specimens, ranging in length from 200 to 295 mm., in the present collection. A common species, used as food. We have here united *G. dasycephalus* and *G. longicephalus,* because it seems certain that the former is the female and the latter the male. Gilbert & Starks (1904) noted that all of their specimens of *G. dasycephalus* were females and that all of their specimens of *G. longicephalus* were males. In our collection the same is true. The rather remarkable differences in the shape and sculpturing of the head, the length of the ventral fins, the height of the anterior part of the anal certainly appear to be merely sexual differences.

It has been known for some time that in some of the species of marine catfishes the male carries the eggs in the mouth until they are hatched. Among our specimens of this species is a male with eggs, measuring about 13 mm. in diameter, in the mouth.

Known only from the Pacific coast of Panama. Our specimens are from Chame Point, Balboa and the Panama City market.

60. Galeichthys seemanni (Günther).

Arius seemanni Günther, Cat. Fish. Brit. Mus., V, 1864, 147 (Central America).

Tachisurus seemanni Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 142, and Occ. Pap. Cal. Ac. Sci., 1890, 78 (Panama).

Galeichthys eigenmanni Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 21, Pl. IV, fig. 7 (Panama Bay).

Galeichthys simondsi Starks, Proc. U. S. Nat. Mus., 1906, 764, figs. 1 & 2 (Callao, Peru).

Galeichthys seemanni Regan, Biol. Cent. Amer., Pisc., 1907, 124.

Head 3 to 3.55; depth 4.4 to 5.45; D. I, 7; A. 16 to 18.

Body rather long anteriorly, the width equal to the depth at origin of dorsal; the tail long and slender, especially so in the male; head low and broad; snout very low, tapering, the margin evenly convex, projecting, its length 3 to 4.3 in head; eye 6.5 to 7.3; interorbital 2.05 to 2.25; mouth nearly wholly transverse, its angle under posterior nostril; teeth in the jaws all sharply pointed, the vomerine and palatine teeth slightly bluntish; upper jaw with a broad, continuous band of teeth, not extending to angle of mouth; mandibular teeth in a narrow band, interrupted on median line, tapering posteriorly and extending beyond angle of mouth; vomerine patches of teeth very variable in size, well separated on median line, separated from the larger palatine patches by a narrow line and a constriction; maxillary barbel reaching to or a little beyond margin of gill-cover; gill-rakers 10 or 11; distance from tip of snout to origin of dorsal 2.45 to 2.7 in length; the upper surface of head and nape rough, granular; the fontanel groove variable in length, not reaching occipital process; occipital process rather broad, variable, with a rather low, blunt, median ridge; dorsal spine 1.55 to 1.7 in head; adipose fin rather short, posteriorly free, inserted a little behind origin of anal, its base 3.65 to 3.9 in head; caudal fin deeply lunate, the upper lobe longest; anal fin rather small, not notably elevated anteriorly in either sex, its base 2 to 2.45 in head; ventral fins small in males, failing notably to reach origin of anal, larger and with a heavy dermal thickening posteriorly in female, and reaching well beyond origin of anal, inserted about equidistant from base of pectoral spine and base of last anal ray; pectoral spine rather large, 1.2 to 1.5 in head.

Color bluish black above, pale below; the fins with more or less dusky, the inside of base of ventrals and pectorals black.

We preserved about 20 specimens, ranging in length from 280 to 350 mm. We follow Regan (1907) in placing *G. eigenmanni* in synonomy, as he compared the type of the present species with paratypes of *G. eigenmanni.* We also unite with this species *G.*

simondsi Starks, the type of which we compared carefully with our material. This species ascends tide streams to brackish water.

Known from Panama to Peru. Our specimens are from Chame Point, Balboa, Corozal and the Panama City market.

61. Galeichthys jordani (Eigenmann & Eigenmann).

Tachisurus jordani Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 142, and Occ. Pap. Cal. Ac. Sci., 1890, 79 (Panama).

Hexanematichthys jordani Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 128.

Galeichthys jordani Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2774; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 22 (Panama Bay).

Head 3.1 to 3.6; depth 3.7 to 4.9; D. I, 7; A. 18 to 19.

Body rather robust, the depth a little greater than the width at origin of dorsal; the tail moderate, compressed; head rather deep; snout not very low, tapering less than in related species, projecting beyond lower lip, its length 3 to 3.8 in head; eye 5.1 to 6.1; interorbital 2 to 2.3; mouth moderate, nearly wholly transverse, its angle under posterior nostril; teeth in the jaws pointed, those on vomer and palatine slightly bluntish; teeth in upper jaw in a broad continuous band, ending in advance of angle of mouth; teeth on lower jaw in a narrower band, interrupted on median line and tapering to a point posteriorly, reaching beyond angle of mouth; vomerine patches of teeth variable in size, well separated on median line, separated from the larger palatine patches by a line and slight constrictions; maxillary barbel reaching to or more usually somewhat beyond base of pectoral spine; gill-rakers 10 or 11; distance from tip of snout to origin of dorsal 2.4 to 2.75 in length; the upper surface of head and nape covered with skin, smooth or only very slightly granular; fontanel groove prominent, not quite reaching occipital process; occipital process broad, with a high, sharp, median ridge; dorsal spine 1.15 to 1.45 in head; adipose fin rather short, posteriorly free, inserted a little behind origin of anal, its base 2.65 to 3.8 in head; caudal fin deeply lunate, the upper lobe longest; anal fin anteriorly somewhat elevated, with outer margin concave in both sexes, its base 1.6 to 2.15 in head; ventral fins notably larger in female than in males and with a very heavy integument on inner side, reaching beyond origin of anal in adult female, failing notably to reach anal in male, inserted about equidistant from base of pectoral spine and middle of base of anal; pectoral fins moderate, the spine 1.15 to 1.6 in head.

Color bluish black above; lower parts silvery; the fins more or less dusky, the inside of ventrals and pectorals largely black.

This species, which is one of the most abundant of the catfishes on the coast of Panama, is represented by about 50 specimens, ranging in length from 95 to 345 mm. It is closely related to *G. seemanni*. Both species are variable and when a large series is compared the differences become slight. Usually, however, the present species may be readily distinguished by the smoother head and nape, the sharper median ridge on the occipital process, the deeper and less strongly pointed snout, larger eye, and the shorter and heavier tail. It ascends tide water streams to brackish water.

Known only from the Pacific coast of Panama. Our specimens are from Chame Point, Balboa and Corozal.

62. Galeichthys guatemalensis (Günther).

Arius guatemalensis Günther, Cat. Fish. Brit. Mus., V, 1864, 145, and Trans. Zoöl. Soc. London, VI, 1868, 393 (Guatemala; Chiapam; Panama); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 18 (Panama; Altata; Magdalena Bay); Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Rio Sabana and Rio Lara, Darien).

Tachisurus guatemalensis Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 43, and Occ. Pap. Cal. Ac. Sci., 1890, 81.

Galeichthys guatemalensis Jordan & Evermann, Bull. U. S. Nat. Mus., 1898, 2778; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 25; Regan, Biol. Cent. Amer., Pisc., 1907, 123.

Head 3.5 to 3.6; depth 5.6 to 5.8; D. I, 7; A. 17 to 19.

Body rather slender; head depressed; snout obtuse; eye moderate, anteriorly placed, 5.7 to 5.8 in head; interorbital 2.15 to 2.25; teeth pointed; vomerine patches of teeth small, separated from each other and from the slightly larger palatine patches by a line and slight constriction; maxillary barbel reaching about to gill-opening; gill-rakers 11; distance from tip of snout to origin of dorsal 2.5 to 2.7 in length; upper surface of head granular, the granules arranged in radiating streaks; occipital process a little longer than broad, its lateral margins nearly straight; fontanel not produced in a groove, appearing as a small elongate pit between posterior part of orbits; dorsal spine 1.7 in head; adipose fin rather small, its base 3.3 to 3.4 in head; caudal fin deeply forked, the upper lobe longest; anal fin moderate, its base 2.15 to 2.3 in head; ventral fins shorter than

pectoral; pectoral spine stronger than dorsal spine, its length 1.6 in head.

Color brownish above; silvery below; the fins dusky.

This species was not taken by us on the coast of Panama, but it is recorded from there by Günther, Steindachner and Boulenger. We examined 3 specimens, U. S. N. M. No. 8144, collected at Colima by J. Xanthus. The above account is based on these specimens. The species appears to differ from related forms occurring on the Pacific coast of Panama in having no backwardly produced fontanel grooves.

Known from Mazatlan to Panama.

63. Galeichthys lentiginosus (Eigenmann & Eigenmann).

Tachisurus lentiginosus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 139, and Occ. Pap. Cal. Ac. Sci., 1890, 50 (Panama).

Galeichthys lentiginosus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 122, and 1898, 2771 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 20 (Panama Bay); Regan, Biol. Cent. Amer., Pisc., 1907, 123 (Panama).

Galeichthys xenauchen Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2777 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 24, Pl. IV, fig. 7 (Panama Bay).

Head 3.65 to 3.9; depth 4.9 to 5.7; D. I, 7; A. 22 to 24.

Body rather slender, the depth at origin of dorsal equal to or a little less than the width; head very low, depressed, lower and broader in the male than in female; snout low, tapering, rather pointed, the margin rounded, 2.8 to 3.3 in head; eye small, 7.75 to 8.1 in head; interorbital 1.9 to 2.25; mouth moderate, the cleft reaching a little beyond the posterior nostril; teeth on the jaws sharply pointed, those on vomer and palatines slightly blunt; mandibular band of teeth well separated on median line, broad anteriorly, tapering to a point posteriorly, and reaching past angle of mouth; teeth on upper jaw in a broad, continuous, crescent-shaped band; vomerine patches of teeth well separated on median line, separated from the somewhat larger palatine patches by a narrow line and slight constriction, maxillary barbel extending to or beyond base of pectoral spine; gill-rakers about 5; distance from tip of snout to origin of dorsal 2.6 to 2.75 in length; upper surface of head and nape mostly covered with skin, smoothest in the male, no very prominent ridges; the frontal fontanel not appearing as a groove externally; occipital process apparently variable in width, narrow posteriorly, very narrow in one specimen, only about

half diameter of eye, about .75 eye in another; dorsal spine rather small, 1.6 to 1.9 in head; adipose fin long, adherent, inserted over about the beginning of the second fourth of anal, its base longer than that of dorsal, 1.6 to 2 in head; caudal fin deeply lunate, the upper lobe longest; anal fin anteriorly not notably elevated in either sex, its base 1.2 to 1.35 in head; ventral fins rather small in the male, failing to reach origin of anal, much larger in female and notably thickened at base posteriorly, reaching well beyond origin of anal, inserted about equidistant from base of pectoral spine and middle of anal base; pectoral fins moderate, the spine 1.5 to 1.9 in head.

Color very dark brown above; silvery below; sides with brownish punctulations; the fins variable, dorsal and caudal yellowish to brown, the other fins pale or with more or less dusky.

Only 3 specimens of this species, respectively 290, 315 and 350 mm. in length, occur in the present collection. We are unable to separate *G. xenauchen* from the present species and follow Regan (1907) in considering it a synonym.

Known only from the Pacific coast of Panama. Our specimens are from the Panama City market.

30. Genus **Netuma** Bleeker.

Netuma Bleeker, Ichth. Archi. Indici, Siluri, I, 1858, 61 (type *Netuma thalassina* Bleeker = *N. nasuta* Bleeker).

This genus differs from *Galeichthys* in having the palatine teeth in large patches with rather long backward projections, extending on pterygoids.

KEY TO THE SPECIES.

a. Fontanel groove well developed, reaching nearly or quite to occipital process; body notably deeper than broad at origin of dorsal; head rather deep and narrow; eye large, 4.6 to 5.4 in head. *platypogon*, p. 113.

aa. Fontanel groove undeveloped, appearing as a broad frontal depression, rarely narrowed into a slight groove posteriorly; body about as broad as deep or broader than deep at origin of dorsal; head low and broad; eye smaller, contained about 6 or more times in head.

b. Occipital process as broad as or broader at base than long on median line.

c. Palatine-pterygoid patches of teeth divided by a deep line or interspace, each patch triangular in shape; frontal depression narrowed into a slight groove posteriorly. *elattura,* p. 115.

cc. Palatine-pterygoid patches of teeth continuous, or only slightly divided by a line, broad anteriorly, tapering uniformly into a long blunt point posteriorly; frontal depression broad, nowhere developed into a groove. *insculpta,* p. 116.

bb. Occipital process much narrower at base than long on median line, the width usually about one-half to two-thirds the length.

d. Body not broader than deep at origin of dorsal; eye moderate, its posterior margin about equidistant from tip of snout and upper angle of gill-opening, 5.85 to 8.5 in head. *planiceps,* p. 117.

dd. Body as broad as, or broader than, deep at origin of dorsal; eye small, its posterior margin notably nearer tip of snout than upper angle of gill-opening, 7.7 to 11.2 in head.

e. Occipital process of moderate width, the width of base about 1.7 in the length; snout moderately projecting; about half the width of band of teeth on upper jaw exposed when mouth is closed. *kessleri,* p. 119.

ee. Occipital process very narrow, the width of base about 2 in the length; snout very strongly projecting; about two-thirds of the width of the band of teeth on upper jaw exposed when mouth is closed. *oscula,* p. 120.

64. Netuma platypogon (Günther).

Arius platypogon Günther, Cat. Fish. Brit. Mus., V, 1864, 147 (San Jose, Guatemala); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 17 (Magdalena Bay, West Coast Cent. Amer.; Callao); Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 44 (Mazatlan; Punta Arenas).

Tachisurus platypogon Eigenmann & Eigenmann, Occ. Pap. Cal. Ac. Sci., 1890, 71 (Panama; Acapulco).

Netuma platypogon Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2767 (Mazatlan); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 28 (Panama Bay).

Galeichthys platypogon Regan, Biol. Cent. Amer., Pisc., 1907, 122, Pl. XVII, fig. 1 & Pl. XIX, fig. 5 (San José; Mazatlan).

Head 3.25 to 3.9; depth 4.15 to 4.9; D. I, 7; A. 18 to 20.

Body moderately slender, notably deeper than broad at origin of dorsal; tail compressed; head rather deep, not very wide; snout obtuse, projecting, its length 2.8 to 3.1 in head; eye 4.6 to 5.4; interorbital 2.1 to 2.2; mouth moderate, its angle slightly behind vertical from posterior nostril; teeth on upper jaw all pointed, in a continuous band of moderate width, failing to reach angle of mouth; teeth on lower jaw slightly bluntish, the band narrower than the one on upper jaw, broadly divided on median line, tapering posteriorly, reaching beyond angle of mouth; vomerine teeth slightly bluntish, the patches small, rarely larger than pupil, separated only by a line from each other and from the palatine teeth, these lines sometimes obsolete; the palatine and pterygoid teeth rather broadly conical, the patches large, but varying in size among individuals, the palatine and pterygoid patches narrowly separated by a line, or continuous, usually but not always pointed posteriorly; maxillary barbel usually reaching base of pectoral spine; gill-rakers 8 or 9; distance from tip of snout to origin of dorsal 2.6 to 2.8; upper surface of head mostly covered with skin, or rather finely granular; occipital process about as long as broad at base, with a rather sharp keel; fontanel groove reaching very nearly or quite to occipital process, extending forward to a little beyond posterior margin of eye; dorsal spine long, compressed, 1 to 1.3 in head; adipose fin moderate, the posterior margin free, its base 2.6 to 3.5 in head; caudal fin forked, both lobes pointed, the upper the longer; anal fin rather small, somewhat elevated anteriorly, the outer margin concave, identical in both sexes, its base 1.55 to 1.8 in head; ventral fins rather small, failing to reach origin of anal, scarcely longer in the female than in the male, but with a dermal integument at base in the former, inserted slightly nearer middle of base of anal than base of pectoral spine; pectoral spine moderate, 1.2 to 1.5 in head.

Color bluish black above; silvery below; the fins pale or greenish, with more or less dusky, the inner surface of the pectorals and ventrals and the anterior part of the anal black.

This species is represented by 30 specimens, ranging in length from 175 to 285 mm. Superficially it resembles *G. jordani* very strongly, but the dentition is different and the fontanel groove reaches very nearly or quite to occipital process, while in *G. jordani* it fails to reach that far back. We have one male at hand with eggs in the mouth, showing that in this species, like several others, the male carries the eggs during incubation.

Known from Lower California to Peru. Our specimens are from Chame Point and Balboa.

65. Netuma elattura (Jordan & Gilbert).

Arius elatturus Jordan & Gilbert, Bull. U. S. Fish. Comm., II, 1882 (1883), 45 (Panama).

Tachisurus elatturus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 142, and Occ. Pap. Cal. Ac. Sci., 1890, 75.

Netuma elattura Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 29.

Head 3.25; depth 4.9; D. I, 7; A. 19.

Body rather low and broad, the depth equal to the width at origin of dorsal; head low and broad; snout short, moderately projecting, its anterior margin broadly rounded, 3.05 in head; eye moderate, its posterior margin somewhat nearer tip of snout than upper angle of gill-opening, 6.9 in head; interorbital 2.05; mouth rather broad, its angle under posterior nostril; teeth in the jaws all pointed, the band on upper jaw continuous, its width about 6 in its length; the band on lower jaw extremely narrow, only about one-fourth as wide as the band on upper jaw, tapering to a point posteriorly, reaching angle of mouth; teeth on vomer, palatine and pterygoids much shorter and blunter than in related species; the vomerine patches elongate, rather narrow, separated from each other by a rather broad interspace and from the palatine teeth by a line; palatine patches triangular with the apex toward the vomerine teeth; pterygoid teeth also in triangular patches, with the apex directed backward and separated from the inner angle of the palatine teeth by a line; maxillary barbel reaching a little beyond base of pectoral spine; gill-rakers very thick and blunt, 7 on lower limb of first arch; distance from tip of snout to origin of dorsal 2.55 in length; upper surface of head moderately granular; occipital process short and broad, its width at base exceeding its length; a broad, shallow fontanel depression, narrowed into a groove posteriorly, reaching back to within half an eye's diameter of occipital process, the depression extending forward on snout to nostrils; interorbital area with few granules and prominent ridges bounding the frontal depression; dorsal spine rather long, 1.5 in head; adipose fin rather long, its base 2.95 in head; caudal fin forked, rather short; anal fin anteriorly somewhat elevated, the outer margin concave, its base 2.25 in head; ventral fins moderate, failing to reach origin of anal (in male), inserted equidistant from base of pectoral spine and middle of anal base; pectoral spine strong, 1.4 in head.

Color dark brown above; lower parts pale, densely covered with brown punctulations; the fins all dusky, the pectorals darkest.

A single male specimen, 325 mm. in length, occurs in our collections. We removed from its mouth 31 eggs, each about 12 mm. in diameter.

Comparing our specimen with U. S. N. M. No. 30995, 300 mm. in length, collected by Rev. Rowell, we find that the latter has the band of teeth on the lower jaw somewhat broader, the vomerine patches larger, the palatine patches smaller and less distinctly triangular and the pterygoid teeth have a longer posterior projection. These teeth on the roof of the mouth are also sharper and longer. The sculpturing of the head is identical. A rare species, known from only a few specimens.

Known only from the Pacific coast of Panama. Our specimen is from Balboa.

66. Netuma insculpta (Jordan & Gilbert).

Arius insculptus Jordan & Gilbert, Bull. U. S. Fish. Comm., II, 1882 (1883), 41 (Panama).

Tachisurus insculptus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 143, and Occ. Pap. Cal. Ac. Sci., 1890, 71.

Netuma insculpta Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 127, and 1898, 2765; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 27 (Panama Bay).

Head 3.5 to 3.6; depth 4.8 to 5.1; D. I, 7; A. 18 to 20.

Body rather robust, the depth about equal to the width at origin of dorsal; head rather short and broad, snout broadly rounded, moderately projecting, 3.1 in head; eye moderate, its posterior margin equidistant from tip of snout and upper angle of gill-opening, 6.8 in head; interorbital 1.95 to 2.2; mouth broad, its angle under posterior nostril; teeth in the jaws conical, apparently a little less sharply pointed than in related species; the band on upper jaw continuous, widest posteriorly, its greatest width about 4 in its length, not exposed when mouth is closed; band on lower jaw less than half as broad as the band on upper jaw, tapering to a point posteriorly, reaching beyond angle of mouth; vomerine and palatine teeth rather blunt; the vomerine patches about half as large as eye, separated from each other and from the palatine-pterygoid patches by lines; the palatine-pterygoid patches slightly divided by a line, rather broad anteriorly, tapering to a long blunt point posteriorly; maxillary barbel reaching well beyond base of pectoral; gill-rakers 7 or 8; distance from tip of snout to origin of dorsal 2.7 in length; upper surface of head granular, the granules extending forward to between the eyes; occipital process at least as broad at base as long, its sides slightly concave, with a rather prominent keel; a broad frontal depression present, but no

groove; the interorbital area and snout with very low ridges; dorsal spine 1.25 to 1.3 in head; adipose fin moderate, the posterior margin free, its base 2.2 in head; caudal fin forked, the upper lobe the longer; anal fin moderate, somewhat elevated anteriorly, the outer margin concave, its base 1.7 in head; ventral fins rather large, reaching origin of anal in specimens at hand, inserted slightly nearer middle of anal base than base of pectoral spine; pectoral spine large, 1.25 in head.

Color brownish above; lower parts pale with brownish punctulations; the fins dusky, the pectorals and ventrals darkest.

The above description is based on 2 specimens, 285 and 330 mm. in length, which we identify as this species. These specimens are close to *N. planiceps,* from which they, however, differ in having a broader and lower head, the upper surface of which is rougher, the occipital process is notably broader at base, the maxillary barbels are longer and the teeth appear to be slightly blunter. In our specimens each palatine-pterygoid patch has a line across it, and the posterior projection is longer than in related species. We have a third specimen, 350 mm. long, which agrees with the other 2 in all respects, except that the occipital process is notably narrower, much as in *N. kessleri,* and the barbels are shorter. Since there appears to be considerable variation among this group of fishes and as there is considerable doubt even in our minds as to whether all the forms recognized in this work are valid species, we hesitate to add another name. We, therefore, tentatively refer this specimen to the present species.

Known only from the Pacific coast of Panama. Our specimens are from Balboa and the Panama City market.

67. Netuma planiceps (Steindachner).

Arius planiceps Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 26, Pl. IV (Panama; Altata); Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 42 (Panama); Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Rio Sabana and Rio Cianati, Darien).

Tachisurus planiceps Eigenmann & Eigenmann, Proc. Cal. Acad. Sci., 2nd Ser., I, 1888, 142, and Occ. Pap. Cal. Ac. Sci., 1890, 71.

Netuma planiceps Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 27 (Panama Bay).

Galeichthys planiceps Regan, Biol. Cent. Amer., Pisc., 1907, 121 (Panama).

Head 3.3 to 3.9; depth 3.75 to 5; D. I, 7; A. 18 or 19.

Body moderately robust, rather deeper than broad at origin of dorsal; head rather short, moderately depressed; snout rather short and broad, obtusely rounded, moderately projecting, 2.85 to 3.1 in head; eye moderate, its posterior margin about equidistant from tip of snout and margin of opercle, 5.85 to 8.5 in head; interorbital 1.75 to 2.2; mouth broad, its angle under posterior nostril; teeth on upper jaw all pointed, in a broad band, slightly divided in middle by a line, failing to reach angle of mouth, its width varying from a little less than one-fourth to a little more than one-fifth of its length, usually not exposed when the mouth is closed; teeth on lower jaw rather less pointed, the band rather broadly divided at symphysis, tapering to a point posteriorly and reaching beyond angle of mouth, its width varying from one-half to three-fourths that of the band on upper jaw; vomerine and palatine teeth bluntish, the vomerine patches very small, usually scarcely larger than the pupil, separated from each other and from the palatine-pterygoid teeth by indefinite lines; palatine-pterygoid patches large, somewhat triangular in shape, very broad anteriorly, tapering rather abruptly posteriorly (One very large specimen 585 mm. long, apparently not distinct from the smaller ones, has on roof of mouth a very large patch of bluntish teeth, which is forked anteriorly, each limb being separated only by a narrow line from the palatine-pterygoid patches. On each side of roof of mouth, behind and to the outside of the palatine-pterygoid patches, is a roundish patch of teeth about as large as eye.); maxillary barbel sometimes failing to reach margin of opercle, sometimes to or slightly beyond base of pectoral spine; gill-rakers 8; distance from tip of snout to origin of dorsal 2.5 to 2.7 in length; upper surface of head rather smooth, the granules small, especially in adult; occipital process of moderate length, its width at base at least 1.5 in the length, tapering posteriorly, its lateral margin nearly straight; with a sharp keel in young, this very low and blunt in adult; frontal depression very broad and shallow or obsolete; no evident fontanel groove; the interorbital area smooth; dorsal spine long, 1 to 1.4 in head; adipose fin rather long, the posterior margin free, its base 2 to 3 in head; caudal fin forked, the upper lobe the longer; anal fin anteriorly more or less elevated, its posterior margin concave; ventral fins longer in females than in males, with a slight integument at base, inserted a little nearer middle of base of anal than base of pectoral spine; pectoral spine long, 1.2 to 1.5 in head.

Color dark brownish above; lower parts pale with a few or many brownish points; the fins all dusky, the inner side of pectorals and

ventrals and at least the anterior part of the anal black.

This species is represented by 20 specimens, ranging in length from 185 to 585 mm.

Known from Sinaloa, Mexico, to Panama. Our specimens are from Chame Point and Balboa.

68. Netuma kessleri (Steindachner).

Arius kessleri Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 24, Pl. V (Altata; Panama); Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 40 (Panama).

Tachisurus kessleri Eigenmann & Eigenmann, Occ. Pap. Cal. Ac. Sci., 1890, 69.

Netuma kessleri Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 26 (Panama Bay).

Galeichthys kessleri Regan, Biol. Cent. Amer., Pisc., 1907, 121 (Panama).

Head 3.1 to 3.9; depth 5 to 6.3; D. I, 7; A. 18 to 20.

Body low and broad, broader than deep at origin of dorsal; head broad, depressed; snout long, broadly rounded, rather strongly projecting, 3 to 3.2 in head; eye very small, its posterior margin notably nearer tip of snout than upper angle of gill-opening, 7.7 to 11 in head; interorbital 2.1 to 2.5; mouth broad, its angle reaching a little beyond posterior nostril; teeth on the jaws all pointed, those on the upper jaw in a broad, continuous band, its width about 4 in its length, about half the width of band exposed when mouth is closed; teeth on the lower jaw in a band about three-fourths as wide as the band on upper jaw, well separated at symphysis, tapering to a point posteriorly, reaching well beyond angle of mouth; vomerine and palatine teeth bluntish; the vomerine patches sometimes united, sometimes narrowly separated in middle, more or less distinctly separated from the palatine-pterygoid patches by a line; the palatine-pterygoid patches triangular in shape, tapering to a point posteriorly; old individuals with a patch of teeth, varying greatly in size with age, behind the palatine-pterygoid patches; maxillary barbels reaching about to margin of gill-covers; gill-rakers 8 or 9; distance from tip of snout to origin of dorsal 2.2 to 2.8 in length; upper surface of the head rather strongly granular; occipital process long, of moderate width, its width at base about 1.7 in its length, the lateral margins nearly straight, with a rather sharp keel; a broad frontal depression present, but no groove; interorbital area and snout smooth or with low broad ridges, the granules extending forward to between the eyes in the

larger examples; dorsal spine 1.5 to 1.9 in head; adipose fin rather large, the posterior margin free, its base 2.5 to 3.1 in head; caudal fin forked, the upper lobe the longer; anal fin moderate, somewhat elevated anteriorly, the outer margin usually slightly concave, its base 2 to 2.4 in head; ventral fins notably longer in the female than in male, inserted about equidistant from base of pectoral spine and base of last anal ray; pectoral spine strong, 1.4 to 1.7 in head.

Color brownish or blackish above; lower parts pale, with or without punctulations; the fins usually dusky, the paired fins pale in some specimens and largely black in others.

This fish is represented by 18 specimens in the present collection, ranging in length from 195 to 470 mm. This species does not appear to ascend tide streams, as all of our specimens are from strictly salt water. A common food fish.

Known from Sinaloa, Mexico, to Guayaquil, Ecuador. Our specimens are from Balboa and the Panama City market.

69. Netuma oscula (Jordan & Gilbert).

Arius osculus Jordan & Gilbert, Bull. U. S. Fish. Comm., II, 1882 (1883), 46 (Panama).

Netuma oscula Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 127, and 1898, 2768; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 28 (Panama Bay).

Tachisurus osculus Eigenmann & Eigenmann, Occ. Pap. Cal. Ac. Sci., 1890, 74 (Panama).

Head 3.05 to 3.2; depth 4.9 to 5.7; D. I, 7; A. 18 to 21.

Body rather low, broad, at least as wide as deep at origin of dorsal; head broad, depressed; snout very long and broad, obtusely rounded anteriorly, projecting very prominently, 3 to 3.4 in head; eye very small, its posterior margin notably nearer tip of snout than margin of opercle, 9.1 to 11.2 in head; interorbital, 2.2 to 2.65; mouth broad, its angle reaching well beyond posterior nostril; teeth on upper jaw all pointed, in a broad continuous band, with or without a line in middle, its width being equal to about one-fourth its length, not quite reaching angle of mouth, about three-fourths of the band exposed when mouth is closed; teeth on lower jaw pointed, the band less than half the width of the one on upper jaw, well separated at symphysis, tapering to a point posteriorly and reaching beyond angle of mouth; vomerine and palatine teeth slightly bluntish, the vomerine patches small, about three-fourths size of eye, separated from each other each by a constriction and a deep line and from the large palatine-pterygoid patches by an indistinct

line; the palatine-pterygoid patches more or less triangular in shape, broad anteriorly, tapering rather abruptly posteriorly; old individuals with a patch of teeth on each side behind the palatine-pterygoid patch, varying in size according to age; maxillary barbel reaching about to base of pectoral spine; gill-rakers 9 or 10; distance from tip of snout to origin of dorsal 2.3 to 2.5 in length; upper surface of head rough, granular; occipital process very long and narrow, its width at base equal to only about half the length, tapering posteriorly, its lateral margins straight to slightly convex, with sharp keel in young, this low and blunt in adult; a large frontal depression present but no fontanel groove; interorbital area and snout with smooth skin and very low ridges; dorsal spine 1.75 to 1.9 in head; adipose fin rather long, the posterior margin free, its base 2.3 to 2.65 in head; caudal fin forked, the upper lobe the longer; anal fin moderate, somewhat elevated anteriorly, the outer margin usually slightly concave, its base 2. to 2.2 in head; ventral fins moderate, failing to reach origin of anal, inserted slightly nearer base of pectoral spine than base of last anal ray or equidistant from these two points; pectoral spine strong, 1.7 to 2 in head.

Color dark brownish above; pale silvery below; the fins greenish, with dark punctulations.

There are 11 specimens of this species in the present collection, ranging in length from 250 to 470 mm. This species differs from *N. planiceps* in several respects, viz., in the lower and broader body, the longer and broader head, the longer and much more prominently projecting snout, the longer and narrower occipital process, the smaller and more anteriorly placed eye, etc. It is probable that the specimens identified by Gilbert & Starks (1904) as *N. oscula* belong to *N. planiceps,* as these authors state that their specimens differed only in having a smaller mouth and a shorter band of teeth on upper jaw. These characters are more or less variable in *N. planiceps* and it is improbable that the many differences enumerated above would have been overlooked. It is also noteworthy that all of our specimens of *N. oscula* were taken in brackish tide streams, while *N. planiceps* was found only in strictly salt water. This species is very closely related to *N. kessleri,* if in fact distinct from it. The only difference which we find that appears to be at all constant is the narrower occipital process in the present species. The snout appears to project a little more strongly and the teeth on the vomer are always in separate patches, having a distinct division in the middle, while in *N. kessleri* this division is often wanting. We should, however, be tempted to regard the two

identical, regardless of these minor structural differences, which appear to be of doubtful value, were it not for the fact that all of our specimens of *N. oscula* were taken in brackish or fresh water, while all those of *N. kessleri* were taken in strictly salt water, thus indicating a difference in habits.

Known only from the Pacific coast of Panama. Our specimens are from Corozal, Canal Zone, and Rio Tuyra, Marriganti, Darien.

31. Genus **Arius** Cuvier & Valenciennes.

Arius Cuvier & Valenciennes, Hist. Nat. Poiss., XV, 1840, 52 (type *Arius grandicassis* Cuvier & Valenciennes).

This genus is readily recognized by the absence of teeth on the vomer and by the broad, granular teeth on the palatines. The palatine patches are of small or moderate size and do not have backward projections.

KEY TO THE SPECIES.

a. Anal fin long, with 23 to 27 rays, the length of its base 1.2 to 1.5 in head; palatine patches of teeth very small, not very blunt; gill-rakers 13. *multiradiatus*, p. 123.

aa. Anal fin shorter, usually with fewer than 23 rays; palatine teeth in larger patches and usually coarser.

b. Teeth on upper jaw in a continuous band or with only a slight constriction at middle; a few of the posterior teeth on lower jaw near symphysis blunt, the rest pointed.

c. Upper surface of head covered with skin, smooth or finely granular; gill-rakers 12 or 13. *melanopus*, p. 124.

cc. Upper surface of head somewhat rougher, granular; gill-rakers 10 or 11.

d. Fontanel groove rarely wanting; if present, it extends from interorbital nearly to occipital process; another small, elongate groove or pit on snout. *fürthii*, p. 125.

dd. Fontanel groove continuous from between posterior nostrils backward nearly to occipital process. *steindachneri*, p. 127.

bb. Teeth on upper jaw in 2 quadrate patches, slightly longer than broad, well separated by a median line and constriction; teeth on lower jaw in a broad band, most of the teeth blunt, only those on anterior margin of band pointed; gill-rakers 13 or 14. *tuyra* sp. nov., p. 128.

70. Arius multiradiatus Günther.

Bagrus (?) *arioides* Kner, Sitzb. k. Ak. Wiss. Münch., 1863, 227 (Rio Bayano, Panama; not of Cuvier & Valenciennes).

Arius multiradiatus Günther, Cat. Fish. Brit. Mus., V, 1864, 173 (based on *Bagrus* (?) *arioides* Kner); Boulenger, Boll. Mus Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Rio Cianati, Darien); Regan, Biol. Cent. Amer., Pisc., 1907, 128 (Panama).

Tachysurus emmelane Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2785.

Tachysurus multiradiatus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 33.

Head 3.3 to 3.9; depth 4.25 to 4.6; D. I, 7; A. 23 to 27.

Body rather slender, the depth considerably greater than the width at origin of dorsal; tail compressed; head rather narrow; snout low, obtuse, moderately projecting, its length 3 to 3.6 in head; eye 4.8 to 6.9; interorbital 1.85 to 2.2; mouth transverse, its angle under posterior nostril; teeth in upper jaw all pointed, in a rather narrower band than in related species, not extending to angle of mouth, a slight constriction on median line; a few blunt teeth near symphysis on lower jaw, the others pointed, the band narrow, reaching beyond angle of mouth; vomerine teeth none; palatine teeth weak, less blunt than in related species, the patches very small, separated by a distance equal to half the diameter of eye; maxillary barbel usually reaching base of pectoral, varying considerably among specimens; gill-rakers 13; distance from tip of snout to origin of dorsal 2.45 to 2.75 in length; upper surface of head rather finely granular, without distinct ridges on interorbital area; occipital process about as broad as long, tapering posteriorly, its lateral margins concave, its keel not very sharp; a frontal depression more or less strongly developed, varying among individuals; fontanel groove present on occiput, extending backward to within half an eye's diameter of the occipital process, also developed as an elongate pit on snout, very similar to typical examples of *A. fürthii;* dorsal spine 1.15 to 1.65 in head; adipose fin rather small, free posteriorly, its base 2.9 to 4 in head; caudal fin very deeply lunate, short, the upper lobe the longer; anal fin anteriorly somewhat elevated, the outer margin usually slightly concave, its base 1.2 to 1.5 in head; ventral fins rather short, reaching nearly or quite to origin of anal, inserted about equidistant from base of pectoral spine and middle of base of anal; pectoral spine rather long, 1.25 to 1.6 in head.

Color bluish black above; silvery below; dorsal and caudal greenish, the other fins pale with dusky points, in some specimens the inner

surface of the pectorals and ventrals and the anterior part of anal mostly black.

This species is here described from 12 specimens, ranging in length from 175 to 285 mm. It may be distinguished from *A. fürthii* by the longer anal and the much smaller patches of palatine teeth. The sexual differences are externally not well marked.

Known only from the west coast of Panama. Our specimens are from Chame Point, Balboa and the Panama City market.

71. Arius melanopus Günther.

Arius melanopus Günther, Cat. Fish. Brit. Mus., V, 1864, 172 (Rio Motagua, Guatemala); Regan, Biol. Cent. Amer., Pisc., 1907, 126, Pl. XVIII, fig. 1, and Pl. XIX, fig. 7 (Rio Motagua, Guatemala).

Tachysurus melanopus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 132 and 1898, 2784.

Galeichthys aguadulce Meek, Field Col. Mus. Pub., Zoöl. Ser., V, 1904, 9, fig. 4 (Rio Papaloapam, Mexico).

Head 3.5 to 3.7; depth 4.05 to 4.7; D. I, 7; A. 22 to 24.

Body rather slender, notably deeper than broad at origin of dorsal; the tail compressed; head rather narrow, low; snout obtusely rounded, projecting, 3.1 to 3.4 in head; eye 5.25 to 7.2; interorbital 2 to 2.5; mouth transverse, its angle under posterior nostril; teeth in upper jaw all pointed, in a rather broad band with a slight constriction in the middle, failing to reach angle of mouth; band in lower jaw slightly narrower than the one in upper jaw, broadly separated on median line, tapering posteriorly, reaching a little beyond angle of mouth, the posterior teeth at symphysis blunt, the others pointed; vomerine teeth wanting; palatine teeth blunt, in rather large club-shaped patches, or small rectangular patches, varying greatly among individuals; maxillary barbel reaching opposite middle, or beyond middle of pectoral spine; gill-rakers 12 or 13; distance from tip of snout to origin of dorsal 2.5 to 2.6 in length; top of head covered with skin, smooth or finely granular; occipital process about as broad at base as long, its lateral margins concave, with a moderately sharp keel; fontanel groove rather prominent, extending nearly to occipital process, usually developed as a small pit on snout; no ridges on interorbital area; dorsal spine 1.2 to 1.4 in head; adipose fin rather small, its posterior margin free, its base 3.3 to 4.7 in head; caudal fin very deeply lunate, the lobes short, rather pointed, the upper slightly the longer; anal fin anteriorly somewhat elevated, the outer margin usually distinctly concave, its base 1.3 to 1.5 in head; ventral fins rather small, usually

reaching about to origin of anal, inserted a little nèarer middle of base of anal than origin of pectoral spine; pectoral spine slender, 1.3 to 1.5 in head.

Color bluish or slightly brownish above; silvery below; dorsal and caudal greenish dusky; the other fins pale with few or many dark points, the distal parts of pectorals and ventrals and the distal part of the anterior rays of anal sometimes black or dusky.

There are over 100 specimens in the collection, ranging from 50 to 240 mm. in length. It is a very common fish on the Atlantic coast of Panama and the only species having 6 barbels. It is most abundant on coral reefs and is rarely taken with drag nets. Although it attains only a small size, smaller than the Pacific coast species of the genus, it is nevertheless a food fish of importance and may be seen on the Colon fish market almost daily. Our specimens appear to differ somewhat from the types as described by Günther and later by Regan in the apparently longer anal fin, there being 22 to 24 rays instead of 21 given by Günther and 19 to 21 by Regan. Regan gives 11 gill-rakers on the lower limb of the first arch, while we find 12 or 13 in the 6 specimens examined for this character. The head appears to be smoother in our specimens than figured by Regan, but as there is considerable variation in this respect among specimens, it is probably of no specific value. The anal rays are rather difficult to enumerate and the gill-rakers can only be seen when the arch is removed or the gill-cover cut so that it may be lifted. It is possible that errors may have arisen in these counts, we therefore regard our specimens as identical with *A. melanopus*. This species is extremely closely allied to *A. fürthii* from which it can scarcely be distinguished. The head is, however, usually notably smoother, never with ridges or prominent granules, and the gill-rakers are more numerous. The sexual differences are externally not evident.

Known from Rio Papaloapam, Mexico, to Panama. Our specimens are from Toro Point, Mindi Reef, and Colon.

72. Arius fürthii Steindachner.

Arius fürthii Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 29 (Panama).

Tachisurus fürthi Eigenmann & Eigenmann, Occ. Pap. Cal. Ac. Sci., 1890, 90 (Panama).

Tachysurus fürthii Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 132, and 1898, 2787 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 32 (Panama Bay).

Tachysurus evermanni Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 32, Pl. V, fig. 10 (Panama Bay).

Arius fuerthii Regan, Biol. Cent. Amer., Pisc., 1907, 127, Pl. XVIII, fig. 2, and Pl. XIX, fig. 8 (Panama).

Head 3.3 to 3.8; depth 4 to 4.35; D. I, 7; A. 20 to 23.

Body rather robust, somewhat deeper than broad at origin of dorsal, posteriorly compressed; head broad, tapering forward; snout rather narrow, little projecting, its length 3.3 to 3.6 in head; eye 6 to 7.4; interorbital 2 to 2.2; mouth transverse, its angle under posterior nostril; teeth on upper jaw all villiform, in a continuous band, not reaching angle of mouth; teeth on lower jaw all pointed, except the posterior ones near symphysis, these blunt like those on palatine, the band broadly separated on median line, becoming narrow posteriorly but not ending in a sharp point, reaching well beyond angle of mouth; vomerine teeth wanting; palatine teeth blunt, in rather large, more or less definitely triangular-shaped patches; maxillary barbel usually reaching to or beyond base of pectoral spine; gill-rakers 10 or 11; distance from tip of snout to origin of dorsal 2.4 to 2.65 in length; top of head with granules, rougher in some specimens than in others; the occipital process about as broad at base as long, with or without a sharp median keel; interorbital area sometimes with 4 prominent ridges, 2 nearly parallel ones on each side of the frontal depression, 2 oblique ones on the outside of these, extending inward and backward from near the posterior nostrils, these ridges low in some specimens and wanting in others; frontal depression obsolete in specimens not having ridges, but usually with a fontanel groove posteriorly, sometimes reaching forward nearly to interorbital and backward nearly to occipital process, another short groove on snout, the latter sometimes obsolete; dorsal spine 1.3 to 1.35 in head; adipose fin moderate, its posterior margin free, its base 3.1 to 4.4 in head; caudal fin very deeply lunate, the lobes short, the upper one longest; anal fin anteriorly somewhat more strongly elevated in the female than in the male, making the margin concave, its base 1.2 to 1.6 in head; ventral fins moderate, failing to reach origin of anal in male, but reaching to or a little beyond origin of anal in female, inserted about equidistant from base of pectoral spine and middle of base of anal; pectoral spine rather long, 1.25 to 1.35 in head.

Color bluish above; pale silvery below; dorsal and caudal greenish dusky, the other fins mostly pale.

This abundant species is represented by about 70 specimens, ranging in length from 210 to 275 mm. The sculpturing of the head,

as shown in the description, is very variable and is apt to lead one into difficulties. We are able to determine from our large series that *A. evermanni* is a synonym of the present species, but we are uncertain about *A. steindachneri,* which we are not quite able to connect with *A. fürthii* by successive steps as in *A. evermanni.* We, therefore, are retaining it as a separate species, but of very doubtful value.

Known only from the Pacific coast of Panama. Our specimens are from Balboa and the Panama City market.

73. Arius steindachneri (Gilbert & Starks).

Arius melanopus Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 29 (Panama; not *Arius melanopus* Günther).

Tachysurus steindachneri Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 29, Pl. V, fig. 9 (Panama Bay).

Head 3.75 to 3.9; depth 4.45 to 4.75; D. I, 7; A. 19 to 22.

Body moderately robust, the depth exceeding the width at origin of dorsal, posteriorly compressed; head moderate, tapering forward; snout rather narrow, moderately projecting, 2.5 in head; eye 4.6 to 4.7; interorbital 2.15 to 2.5; mouth transverse, its angle under posterior nostril; teeth as in *A. fürthii;* maxillary barbel reaching to middle of pectoral spine; gill-rakers 11; distance from tip of snout to origin of dorsal 2.6 to 2.7 in length; sculpturing of head very similar to that variety of *A. fürthii* that has no prominent ridges on head and no prominent fontanel depression, differing only in having the frontal groove continuous from between posterior nostrils to within half diameter of eye from occipital process; dorsal spine 1.25 in head; adipose fin moderate, its posterior margin free, inserted a little behind origin of anal, its base 2.75 to 3 in head; caudal fin deeply lunate; anal fin anteriorly moderately elevated, its outer margin a little concave, its base 1.4 to 1.45 in head; ventrals moderate, inserted about equidistant from base of pectorals and middle of base of anal; pectoral spine moderate, 1.3 to 1.35 in head.

Color bluish above; pale silvery below; fins all with dark points, the pectorals, ventrals and anterior part of anal largely black in our smallest specimen.

We have 3 specimens, respectively 135, 175 and 180 mm. in length, upon which the above description is based. They differ from *A. fürthii* only in having the fontanel groove continuous from between the posterior nostril to within a short distance from the occipital

process. This was, however, shown to be a very variable character in *A. fürthii,* and of very doubtful value.

Known only from the Pacific coast of Panama. Our specimens are from Balboa.

74. Arius tuyra sp. nov. (Plate V.)

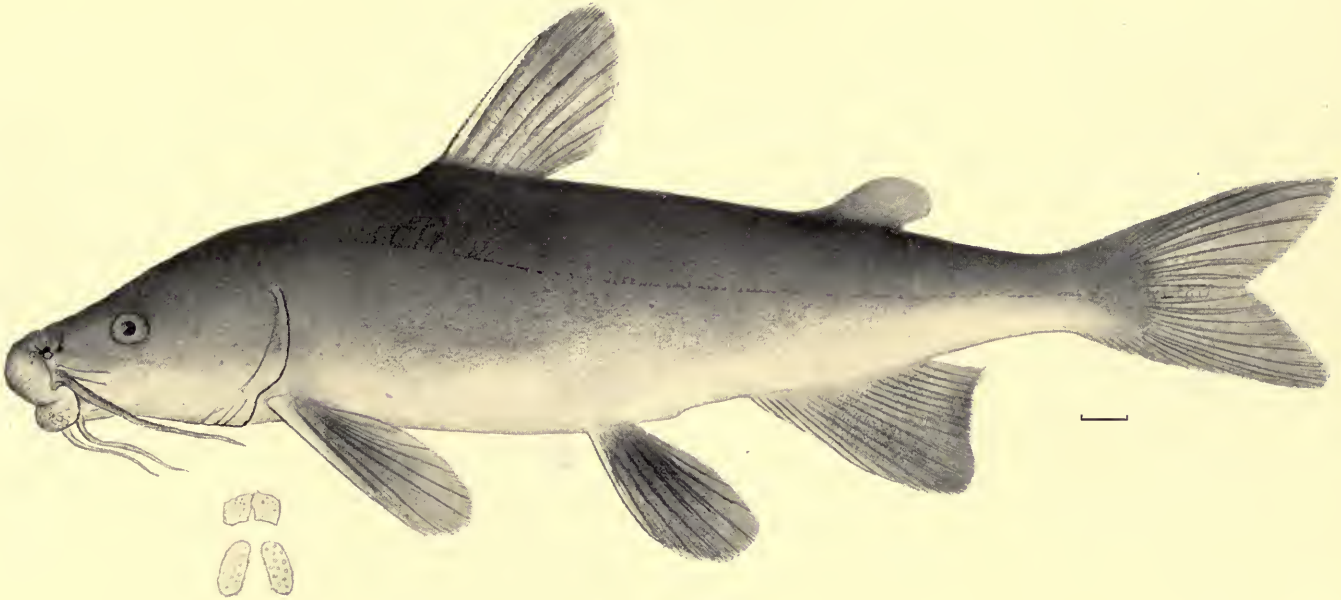
Type No. 79413, U. S. N. M.; length 260 mm.; Rio Tuyra, mouth of Rio Yape, Darien, Panama.

Head 3.5 to 4; depth 4.4 to 5; D. I, 7; A. 20.

Body rather slender, notably deeper than broad at origin of dorsal; tail compressed; head narrow; snout tapering, rather pointed, projecting, 2.85 to 3.3 in head; eye 5.5 to 7.2; interorbital 2.15 to 2.45; mouth small, its angle under posterior nostril; the lips apparently varying greatly in thickness, very heavy in some individuals, thin in others, this regardless of sex or spawning condition; teeth on upper jaw pointed, in 2 quadrate patches, slightly longer than broad, separated by a median line and constriction, not nearly reaching angle of mouth; lower jaw mostly with blunt teeth, only those on anterior margin of band pointed, the band very broad, exceeding in width the patches on upper jaw; vomerine teeth wanting; palatine patches elongate, well separated, rather small, the teeth very coarse, paved; maxillary barbel reaching to or beyond base of pectoral spine; gill-rakers 13 or 14; distance from tip of snout to origin of dorsal 2.3 to 2.5 in length; the upper surface of head finely granular, varying somewhat among individuals; the occipital process notably longer than broad at base, with a rather prominent median keel; fontanel groove failing to reach occipital process by half the diameter of eye, appearing on snout as an elongate pit, the latter obsolete in one specimen; no prominent ridges on interorbital region; dorsal spine 1.2 to 1.5 in head; adipose fin moderate, the posterior margin free, its base 3.75 to 4.1 in head; caudal fin forked, the lobes rather long, pointed, the upper one longest; anal fin rather strongly elevated, the outer margin concave, its base 1.5 to 1.8 in head; ventral fins, inserted a little nearer middle of base of anal than base of pectoral spine; pectoral spine 1.4 to 1.7 in head.

Color bluish or slightly brownish above; silvery below; the fins greenish, with more or less dusky, the inner side of pectorals and ventrals often mostly black.

This species is represented by 13 specimens, ranging in length from 95 to 290 mm. These fish were all taken in fresh or brackish water, some of them 25 miles above the head of the tide. A very remarkable



ARIUS TUYRA sp. nov.
From a paratype U. S. N. M. No. 79414.

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variation occurs with respect to the thickness of the lips, which does not seem to be related to sex, age or spawning condition. If we had had only the extremes, we should have regarded them as distinct, but fortunately we have a few intermediate specimens which show rather conclusively that the size of the lips has no specific value. The sexual differences are externally not evident. The species differs from all related forms in the dentition, the teeth in upper jaw being in 2 quadrate patches, the teeth in lower jaw mostly blunt and in a very broad band and the palatine teeth coarser and blunter. The form is rather more elongate, the occipital process longer and the tail with longer and more pointed lobes.

Our specimens are from the Rio Tuyra, at Marriganti, Boca de Yape and Boca de Cupe.

32. Genus **Cathorops** Jordan & Gilbert.

Cathorops Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 54 (type *Arius hypophthalmus* Steindachner).

This genus is characterized by the numerous gill-rakers, there being not fewer than 30 on the lower limb of the first arch. The eye is placed low, partly below the level of the mouth.

KEY TO THE SPECIES.

a. Snout strongly projecting; width of mouth 2.5 in head.
hypophthalmus, p. 129.

aa. Snout little projecting; width of mouth 2 in head.
gulosus, p. 130.

75. Cathorops hypophthalmus (Steindachner).

Arius hypophthalmus Steindachner, (Sitz. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 31, Pl. X (Panama); Regan, Biol. Cent. Amer., Pisc., 1907, 128.

Cathorops hypophthalmus Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 53 (Panama); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 133; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 33.

Tachisurus hypophthalmus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 146, and Occ. Pap. Cal. Ac. Sci., 1890, 92 (Name only).

"Head 3⅗. A. 22. Body elongate; head long, narrow, depressed; palatine teeth small, bluntly conic, almost granular; vomerine bands widely separate, each confluent with the large palatine band, which is not produced backward; both jaws thin, depressed, with narrow bands

of teeth; barbels very long; the maxillary reaching near middle of pectoral spine; dorsal spine long; pectoral shorter; dorsal shield small; occipital process subtriangular, longer than broad, its sides concave, its middle angular but not keeled; fontanelle long and narrow, not quite reaching occipital process; shields of head rugose, with reticulating furrows. Fins mostly pale. Eye small, placed low, its middle below level of angle of mouth. L. 14 inches." (Jordan & Evermann.)

This fish was not seen by us. Recorded from Panama by Steindachner and by Jordan & Gilbert. Apparently a rare species.

Known only from the Pacific coast of Panama.

76. Cathorops gulosus (Eigenmann & Eigenmann).

Tachisurus gulosus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2nd Ser., I, 1888, 146, and Occ. Pap. Cal. Ac. Sci., 1890, 93 (Panama).

Cathorops gulosus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 133; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 33 (Panama).

Head 3.4 to 3.5; D. I, 7; A. 23.

Body elongate, slender, the greatest width scarcely less than the depth; head broad, strongly depressed, its greatest width 1.5 in its length; snout not projecting; eye on level with angle of mouth, its diameter 8 in head; interorbital space 2; mouth rather wide, 2.3 to 2.4; teeth on jaws pointed; the band on upper jaw narrower in middle; the band on lower jaw a little narrower; vomerine teeth none; palatine teeth obtusely conical, the patches separated by a distance equal to 1.5 diameter of eye or less; maxillary barbel reaching middle of pectoral spine or shorter; gill-rakers 30; distance from tip of snout to origin of dorsal 2.5 in length; upper surface of head granular; occipital process about as long as broad, with a low keel; fontanel groove narrow, extending backward to within .75 diameter of eye to occipital process; fontanel anteriorly margined by bony ridges; dorsal spine 1.33 in head; adipose fin as high as long; upper lobe of caudal the longer and more sharply pointed; anal fin with outer margin concave; pectoral spine 1.6 in head.

Color bluish gray above; silvery below; dorsal and caudal slightly dusky; the other fins plain.

This species was not seen by us. Recorded from Panama by Eigenmann & Eigenmann and by Gilbert & Starks. A rare species, known only from 4 specimens from the Pacific coast of Panama. The above description is compiled from published accounts.

Order VI. Synbranchia.

Family XVII. Synbranchidæ.

Body eel-shaped; the tail much shorter than rest of body; snout short; eyes anterior; teeth small, the palatine teeth in a band; gill-openings small, confluent, wholly inferior; gills 4; scales wanting.

33. Genus **Synbranchus** Bloch.

Synbranchus Bloch, Ichthyol., IX, 1795, 86 (type *Synbranchus marmoratus* Bloch).

Unibranchapertura Lacépède, Hist. Nat. Poiss., V, 1803, 656 (type *Synbranchus marmoratus* Bloch).

Ophisternon McClelland, Journ. Nat. Hist. Calcutta, V, 1844, 197 (type *Ophisternon bengalensis* McClelland).

Characters of the genus are included in the family description. A single American species is known. It inhabits fresh water.

77. **Synbranchus marmoratus** Bloch.

Synbranchus marmoratus Bloch, Ichthyol., IX, 1795, 87, Pl. CCCCXVIII.

Synbranchus immaculatus Bloch, Ichthyol., IX, 1795, 87, Pl. CCCCXIX, fig. 1.

Synbranchus transversalis Bloch & Schneider, Syst. Ichthyol., 1801, 524 (Guinea).

Unibranchapertura grisea and *lineata* Lacépède, Hist. Nat. Poiss., V, 1803, 658 (Surinam).

Synbranchus fuliginosus Ranzani, Nov. Comment. Ac. Sci. Inst. Bonon., IV, 1840, 75, Pl. XI, fig. 1 (Brazil).

Muræna lumbricus Gronow, Cat. Fish, 1854, 18 (Sea of Guinea).

Synbranchus vittatus Castelnau, Anim. Nouv. Rares Amér. Sud, 1855, 84, Pl. XLIV, fig. 3 (Rio de Janeiro).

Symbranchus marmoratus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 34 (Miraflores); Evermann & Goldsborough, Proc. Biol. Soc. Wash., XXII, 1909, 101 (Rio Boqueron, Panama).

Body elongate, not much wider than deep; the tail short, 2.9 in head and trunk; head rather large, 7.3 in head and trunk; depth 2.85 in head; snout blunt, projecting beyond mouth, 6.65 in head; eye small, anterior, scarcely half as long as snout; mouth large, reaching far beyond eye; the gape 3.2 in head when measured from tip of lower

jaw to angle of mouth; teeth rather blunt, in bands on jaws and palatines; gill-opening small, roundish, not extending to the edge of the ventral surface; origin of the dorsal slightly in advance of vent, the fin appearing only as a dermal fold, confluent around the tail with the very feebly developed anal; pectoral fins wanting.

Color variable, usually variously marbled with yellow. The specimen at hand is uniform dark brown above; abdomen pale; sides and lower surface of head spotted or punctulate with brown.

A single specimen, 293 mm. long, was picked up on the lower Rio Cana, Pacific slope of Darien, by Mr. E. A. Goldman, having been dropped, uninjured, by a bird. The species was not seen by us during our extensive collecting. Gilbert & Starks record it from Miraflores on the Canal Zone, where they say it was abundant in a fresh water pond and trapped for food. These authors suggest that it burrows, as no specimens could be taken with a seine. This eel is also recorded from Panama, from the Rio Boqueron, an upper tributary of the Rio Chagres, by Evermann and Goldsborough. A record of this specimen should have been included in our report on the fresh water fishes of Panama, but it was overlooked at the time that report was prepared.

Known from Cuba, Vera Cruz to La Plata and Peru; both slopes of Guatemala and Panama.

Order VII. Carenchelyi.

Family XVIII. Derichthyidæ.

Body anguilliform, slender; head oblong; snout short; eyes lateral, in anterior half of head; jaws well developed; maxillaries and premaxillaries developed; anterior nostrils entirely above upper lip, not tubular; tongue moderately developed; branchial apparatus as in Apodes, the apertures lateral, vertical, in front of pectorals.

We refer our single specimen tentatively to this family, which heretofore has been represented by a single genus and species, apparently based upon one specimen from the Gulf Stream taken at 39° 44′ 30″ N. lat., 70° 04′ W. lon., at a depth of 1,022 fathoms. Our specimen has much in common with the previously described representative of this family, but it differs in the absence of a neck-like contraction, the vent is much farther forward, the mouth is smaller and more oblique, the dorsal and anal fins are not confluent around the tail, and the pectoral fins are not bent forward.

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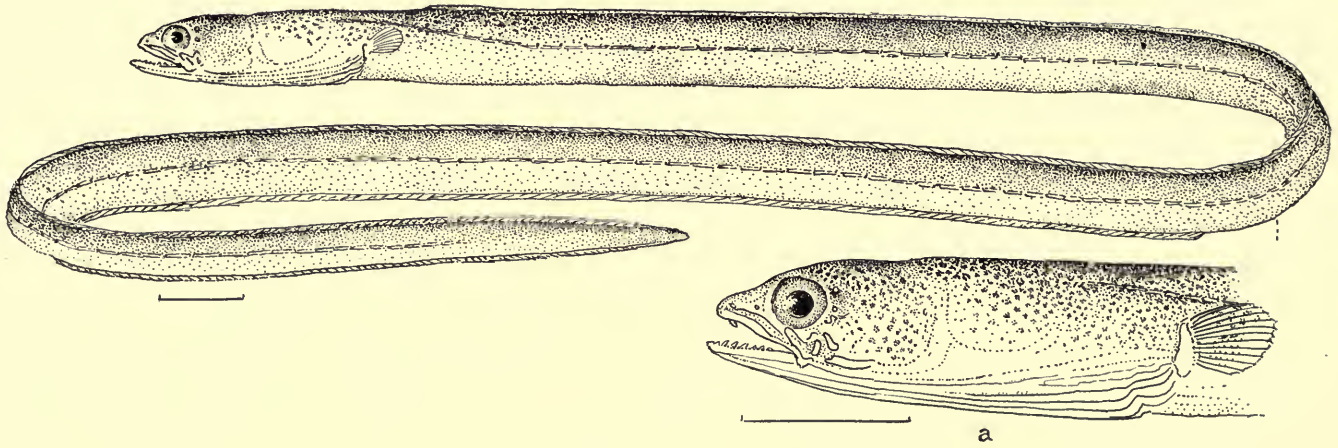

GORGASIA PUNCTATA gen. et sp. nov.
a. Lateral view of head, enlarged.
Drawn from type 500 mm. in length.

34 Genus **Gorgasia** gen. nov.

Type *Gorgasia punctata* sp. nov.

Body slender, snake-like; head oblong; snout very short; eye large, lateral; nostrils in front of eyes, the anterior pair entirely above the upper lip, with only a rudiment of a tube; mouth moderate, oblique, the gape not extending beyond eye; upper lip not continuous with the skin of the head except on median line of snout; teeth pointed; tongue anteriorly largely free; pectoral fins present, short, rather poorly developed; tip of tail without the rudiment of a fin, ending in a hard, sharp edge; vent much in advance of median half of body.

We take pleasure in naming this genus for the late General William Crawford Gorgas, who was chief sanitary officer on the Panama Canal Zone during the period when the present collections were made, and through whose department the authors received invaluable aid while collecting in Panama.

78. **Gorgasia punctata** sp. nov. (Plate VI.)

Type No. 82,222, U. S. N. M.; length 500 mm.; Chame Point, Panama.

Body nearly round, slender; the tail very long, nearly as robust as body, 2.6 times the length of the rest of body, 1.37 in total length; head moderate, not much deeper than broad, 5.2 in head and trunk; depth 2.9 in head; snout very short, pointed, scarcely as long as lower jaw, 8.7 in head; eye large, lateral, longer than snout, 6.85 in head; interorbital expanding rapidly posteriorly, its least width 10 in head; mouth small, oblique; the gape extending under posterior margin of pupil, 3.9 in head when measured from tip of lower jaw to angle of mouth; teeth pointed, in narrow bands on anterior part of jaws, uniserial at sides, directed backward; vomer with a single series of rather larger recurved teeth; anterior nostril near tip of snout, but above the lip, the margin elevated, forming a slight tube; posterior nostril elongate, situated in front of eye; the upper lip not continuous with the skin of the head, except at tip of snout; gill-opening small, lateral, not more than half as broad as isthmus; origin of dorsal just behind the tip of pectoral; the vertical fins moderately developed, not confluent around the tail; pectoral fins small, not much longer than gill-opening, 7.45 in head.

Color greenish brown above, pale below; body everywhere except on chin with dark punctulations, forming small spots on head and anterior part of body.

A single specimen, 500 mm. long, of this peculiar eel was sent from Chame Point by Mr. Robert Tweedlie.

Order VIII. Apodes.

Family XIX. Anguillidæ.

The True Eels.

Body elongate, snake-like; mouth terminal or nearly so; teeth in bands on jaws and vomer; gill-openings slit-like; nostrils double, rather far apart, the anterior ending in a short tube; air bladder with open duct; vertebræ numerous; the tail isocercal; scales small, linear, embedded, oblique, often placed at right angles to each other; dorsal fin inserted at a considerable distance from the head, continuous with anal around the tail; pectorals well developed.

One genus known, consisting of probably about 4 or 5 species. Widely distributed, found in most tropical and temperate waters, but not on the eastern Pacific coast.

35. Genus **Anguilla** Shaw.

Anguilla Shaw, Gen. Zoöl., IV, 1803, 15 (type *Anguilla vulgaris* Shaw).

The characters of the genus are included in the family description. A single American species is known, but on account of considerable variation in structure and color it has been given many names.

79. Anguilla rostrata (Le Sueur).

Muræna rostrata Le Sueur, Journ. Ac. Nat. Sci. Phila., I, 1817, 81 (New York). For complete synonomy see Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, p. 348.

Anguilla rostrata Evermann & Goldsborough, Proc. Biol. Soc. Wash., XXII, 1909, 101 (Caldera Island, Porto Bello Bay).

Body rather robust, the depth 16 in total length; head broad, depressed, much broader than deep, 9.3 in total length; snout broad, 5.3 in head; eye lateral, 9.6; mouth horizontal, rather large, the gape reaching nearly to posterior margin of eye, 3.3 in head; the lower jaw projecting; teeth small, in bands on jaws and vomer; nostrils remote from each other, the anterior one slightly behind margin of upper jaw, ending in a short tube; gill-opening rather large, just in front of and below base of pectoral; vent close in front of anal; scales small, linear, embedded, oblique and usually at right angles to each

other; origin of dorsal about half as far from origin of anal as from tip of snout; dorsal and anal confluent around caudal; pectoral fins rather large, 1.9 in head.

Color bluish gray above; pale below.

A single specimen, 990 mm. long, of this fresh water eel was seen. According to the native, who caught this specimen with hook and line, the species is not very rare in the Rio Trinidad. It is apparently not valued as food, as the native angler was cutting small pieces of flesh from its side for bait. This eel should have been included in the report on the fresh water fishes of Panama, but it was overlooked when that report was prepared. However, as it goes to sea to spawn, and spends the leptocephalid stage of its life in salt water, it is not out of place in the present work. This eel produces a very large number of eggs which are deposited in mid-ocean. The young, or leptocephalidæ, are thin, ribbon-shaped and transparent as in some of the other eels and undergo a metamorphosis. Soon after reaching the adult form they migrate to fresh water.

This eel is known from the Atlantic slope of North America from southern Canada to Panama. Our specimen is from the Rio Trinidad, the largest tributary of the Rio Chagres. Also recorded from Caldera Island, Porto Bello, by Evermann & Goldsborough.

Family XX. **Leptocephalidæ.**

The Conger Eels.

Body formed as in *Anguilla,* elongate, posteriorly compressed; tongue largely free in front; posterior nostril well above the lip, near front of eye; scales entirely wanting; the tail surrounded by a fin; pectoral fins well developed.

A single genus (*Ariosoma*) of this family is represented in the present collection, but we include in our discussion another (*Leptocephalus*), which is almost cosmopolitan in its distribution and, although not taken by us, it doubtlessly occurs on the Atlantic coast of Panama.

Numerous specimens of larvæ, possibly belonging to this family, occur in our collections. These we are able to separate into two apparently distinct forms. One form, of which we have only 2 apparently very young specimens, 62 and 95 mm. in length, may be characterized thus:

Body very thin, transparent, ribbon-shaped, rather long and narrow, the depth about 11 to 13 in total length; head small, abruptly

narrower than body, pointed; mouth large, terminal, reaching under middle of eye; teeth prominent, hair-like, directed forward, some of them projecting beyond mouth; nostrils both above lip, the anterior near tip of snout, the posterior close in front of eye; gill-opening small, lateral, vertical or nearly so; dorsal fin not developed as a true fin, appearing as a cutaneous fold beginning in advance of gill-opening; anal fin fold beginning not far behind head, developed as a distinct fin behind middle of body, confluent with the dorsal around the tail; pectoral fins well developed, a little longer than eye.

Of the other form we have many specimens, ranging in length from 45 to 120 mm., including apparently very young larvæ, which have not attained the largest size reached in the larval form, and large larvæ, 120 mm. long, which appear to be the maximum size reached by the larvæ. After this stage is reached the tissues become more compact, the body becoming thicker and shorter. The body in the form at hand is probably reduced to a length of about 45 mm., as we have a specimen of that size which has essentially assumed the rounded form of most eels. There is doubtlessly considerable variation in this respect among individuals, as indicated by specimens at hand. Although we have a fairly complete series from the very young to and approaching the adult form as described above, we are unable to identify these specimens with any known form. The position which the anterior nostril will assume in the adult is uncertain. In our oldest specimen it is still above the lip, but it seems probable that it may become enveloped in the lip as the latter thickens. The place of origin of the dorsal fin too is still uncertain, as a cutaneous fold precedes the differentiated portion. A description of this form follows:

Body in youngest forms very thin, transparent, ribbon-shaped, notably deeper than in older forms, the proportionate depth decreasing before the larva reaches its greatest length (about 110 mm.), a gradual thickening of the tissues and a decrease in length then ensues, until reaching a length of approximately 45 mm., when the body becomes essentially eel-shaped; depth about 8 or 9 in total length in young larvæ 90 mm. in length, 10 or 11 in total length in larvæ having reached their maximum length (about 115 mm.), the proportions remaining about the same thereafter, the length and depth decreasing uniformly; head moderate; snout pointed, projecting moderately beyond the mouth, with a downward curved tip; mouth large, the gape reaching under posterior margin of eye; teeth long, slender, largest in youngest forms, reduced in the older ones;

nostrils not labial, the anterior near tip of snout, the posterior close in front of eye; gill-slits small, vertical; a cutaneous fold on back beginning on head, the oldest individuals with differentiated fin beginning about equidistant from gill-opening and vent; anal fin similar in development to dorsal, confluent with it around the tail; pectoral fin a mere rudiment, appearing as a dermal flap.

The two larval forms above described may readily be separated by the much narrower body, comparing specimens of like size, and by the well developed pectoral fin of the first described species. We have no larval specimens of *Leptocephalus conger* at hand, with which species most larval eels which have been taken are identified, but as this eel is not known from the eastern Pacific, it is not probable that any of the specimens at hand, which are all from the Pacific coast, belong to that species.

KEY TO THE GENERA.

a. Dorsal fin inserted behind base of pectoral; vomer with a band of villiform teeth. *Leptocephalus,* p. 137.

aa. Dorsal fin inserted over gill-opening; vomer with a broad quadrangular or triangular patch of teeth in front, not elongated into a band. *Ariosoma,* p. 138.

36. Genus **Leptocephalus** Gronow.

Leptocephalus Gronow, Zoöphyl., 1763, 135 (type *Leptocephalus morrisi* Gmelin). For complete synonomy see Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, p. 353.

Body formed as in *Anguilla,* elongate, posteriorly compressed; head depressed; snout pointed; mouth large, extending at least to below middle of eye; lower jaw projecting; teeth in outer series in each jaw close set, forming a cutting edge, no canines; posterior nostril near eye, anterior nostril near tip of snout, ending in a short tube; scales wanting; origin of the dorsal behind pectorals; dorsal and anal confluent around the tail; pectoral fins large.

80. **Leptocephalus conger** (Linnæus).

Muræna conger Linnæus, Syst. Nat., Ed. X, 1758, 245 (Mediterranean).

Leptocephalus conger, Jordan & Davis, Rept. U. S. Fish Comm., XVI, 1888 (1892), 664. For complete synonomy see Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, p. 354.

Body elongate, rounded; the tail longer than rest of body; head somewhat depressed above, a little more than half the length of trunk; depth not quite equal to half the length of head; snout acute, 3.25 to 4.25 in head; eye rather small, about 1.5 in snout; mouth large, the gape reaching under posterior margin of eye; upper lip thick, with conspicuous pores; lateral line with large pores; origin of dorsal over tip of pectoral, the fin rather high, similar to anal and confluent with it around the tail; pectoral fins moderate, 3.5 in head.

Color black or dark olive green above, white beneath; vertical fins with black margin.

This is a very widely distributed eel, found almost everywhere in the warmer seas, but not in the eastern Pacific. It was not taken by us on the Atlantic coast of Panama but it doubtlessly occurs there.

Known on the Atlantic coast of America from Massachusetts to Uruguay.

37. Genus **Ariosoma** Swainson.

Ariosoma Swainson, Nat. Hist. & Class. Fish., I, 1838, 220 (no type named; later restricted by Bleeker and by Swain to *Ophisoma acuta* Swainson=*Muræna balearica* Delaroche).

Congermuræna Kaup, Cat. Apod. Fish Brit. Mus., 1856, 108 (restricted by Bleeker to *Muræna balearica* Delaroche).

Congrellus Ogilby, Proc. Linn. Soc. N. S. W., XXIII, 1898, 288 (type *Muræna balearica* Delaroche).

This genus is characterized by the pointed teeth, the prominent muciferous cavities in the head and by the anterior insertion of the dorsal fin, which arises over the gill-opening.

KEY TO THE SPECIES.

a. Body moderately robust; the tail rather short and heavy, longer than rest of body by a distance equal to length of snout, 1.85 in total length; vomerine teeth in a triangular patch, with a rather long backward projection. *balearica*, p. 139.

aa. Body more elongate; the tail long, tapering but not filamentous, a little more than 1.5 times the rest of body, 1.62 in total length; vomerine teeth a in triangular patch, with a very short backward extension. *prorigera*, p. 140.

aaa. Body very elongate; the tail very long, tapering, filamentous, nearly 2.5 times the length of the rest of body, 1.35 in total length; vomerine teeth in a small, quadrate patch, no backward extension. *nitens*, p. 140.

81. Ariosoma balearica (Delaroche).

Murœna balearica Delaroche, Ann. Mus. Hist. Nat. Paris, XIII, 1809, 327, fig. 3 (Balearic Islands).

Conger opisthophthalmus Ranzani, Novi Comment. Ac. Sci. Inst. Bonon., IV, 1840, 78, Pl. XII, fig. 1 (Bahia).

Conger microstomus Castelnau, Anim. Nouv. Rares Amér. Sud, 1855, 83, Pl. XLIII, fig. 4 (Rio Janeiro).

Conger impressus Poey, Memorias, II, 1861, 318 (Cuba).

Congermurœna balearica Kaup, Cat. Apod. Fish Brit. Mus., 1856, 110; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 356.

Ophisoma balearicum Jordan & Davis, Rept. U. S. Fish Comm., XVI, 1888 (1892), 661.

Ophisoma (?) *balearicum* Gilbert, Proc. U. S. Nat. Mus., 1891, 349 (Panama Bay, Albatross Station 2797).

Congrellus gilberti Ogilby, Proc. Linn. Soc. N. S. W., XXIII, 1898, 288 (Panama; based on Gilbert's description); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 34.

Body moderately elongate; the tail rather short and heavy; longer than the rest of body by a distance scarcely longer than snout, 1.85 in total length; head moderate, 2.5 to 2.8 in head and trunk; depth 2.8 in head; snout conical, slightly projecting, 4.25 to 5 in head; eye 4.7 to 5.6; mouth moderate, reaching under anterior margin of pupil, the gape 3.4 to 3.8 in head; teeth all pointed, in villiform bands on jaws, vomer with a triangular patch of teeth with a rather long projection posteriorly; gill-opening lateral, nearly vertical, much narrower than isthmus; origin of dorsal over gill-opening, the fin rather low, similar to anal and confluent with it around the tail; pectoral fins narrow, 2.8 to 3.1 in head.

Color uniform brownish; the vertical fins with black margins, at least posteriorly.

This eel was not taken by us. It is here described from 2 specimens, 135 and 210 mm. in length. The larger one is from Cuba, presumably identified by Poey as *C. impressus,* which authors have referred to the synonomy of *A. balearica.* The smaller one is from Panama Bay, Albatross Station 2797. We have carefully compared these specimens but fail to find any characters to separate the two. Ogilby's name, *C. gilberti,* proposed for the Pacific coast specimens from Panama Bay must therefore be referred to the synonomy of *A. balearica.*

This widely distributed eel is known on the American coasts from Cuba to Rio Janeiro and from Cape San Lucas to the Galapagos Islands.

82. Ariosoma prorigera (Gilbert).

Ophisoma prorigerum Gilbert, Proc. U. S. Nat. Mus., 1891, 350 (Coast of Ecuador; Panama).

Congermuræna prorigera Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 357.

Congrellus proriger Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 34.

Body moderately robust, compressed, the tail tapering, but not filamentous, a little more than 1.5 times the length of the rest of the body, or 1.62 in total length; head large, 2 in head and trunk; depth 2.15 in head; snout projecting rather prominently, bluntish, 4.5 in head; eye 8.25; mouth large, reaching under posterior margin of pupil, the gape 3.5 in head; teeth as in *A. nitens;* gill-opening vertical, narrower than the isthmus; origin of the dorsal over gill-opening, the fin well developed, similar to anal and confluent with it around the tail; pectoral fins rather large, 3.3 in head.

Color uniform brownish; vertical fins pale anteriorly, black on posterior part of tail; pectorals pale.

This eel was not obtained by us. A small specimen was dredged in Panama Bay by the Albatross at Station 2799.

Known from Panama Bay and off the coast of Ecuador.

83. Ariosoma nitens (Jordan & Bollman).

Ophisoma nitens Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 153 (Panama Bay, Albatross Sta. 2801); Gilbert, Proc. U. S. Nat. Mus., 1890, 450 (Panama Bay, Albatross Sta. 2799).

Congermuræna nitens Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 357.

Congrellus nitens Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 34.

Body anteriorly moderately slender, tapering posteriorly; the tail becoming very slender, filamentous, nearly 2.5 times the length of rest of body, 1.35 in total length; head rather large, 1.9 in head and trunk; depth 3 in head; snout rather long, prominently projecting, 4 in head; eye lateral, rather large, the horizontal diameter much greater than the vertical, the former 1.75 in snout, 6.9 in head; mouth large, reaching under posterior margin of eye; the gape 3.65 in head when measured from tip of lower jaw to angle of mouth; teeth all pointed, in bands on jaws, vomer anteriorly with a broad patch of

teeth, none on shaft; gill-opening lateral, not broader than the isthmus; origin of the dorsal slightly in advance of gill-opening, the fin well developed, rather high, similar to the anal and confluent with it around the tail; pectoral fins rather large, 3.15 in head.

Color pale or slightly yellowish; the back with numerous dark points; dorsal and anal anteriorly with dark points, becoming black posteriorly.

A single small specimen, 150 mm. long, was sent from Chame Point by Mr. Robert Tweedlie. We compared our specimen with the type, from which it appears to differ slightly in the more prominently projecting snout and in the broader pectorals. This species is related to *A. flavus,* from which it, however, differs in the much longer tail. The tail in *A. flavus* is a little less than twice the length of the rest of the body.

A rare species previously known only from 2 specimens taken in Panama Bay by the Albatross. Our specimen is from Chame Point.

Family XXI. Muræsocidæ.

Body elongate, moderately slender; the jaws not greatly produced; tongue largely adnate to the floor of the mouth; vomer well armed with teeth; the posterior nostril not labial; the vertical fins confluent around the tail; pectoral fins well developed.

KEY TO THE GENERA.

a. Dorsal and anal fins well developed throughout; origin of dorsal nearly over gill-opening.
b. Tail less than twice the length of the rest of body; the jaws with 3 series of teeth; vomer with several series of teeth, the median series of enlarged compressed teeth; well developed canines on anterior port of jaws. *Muræsox,* p. 141.
bb. Tail about four times the length of the rest of body; the jaws with 2 series of teeth; vomer with one series of long, pointed canines. *Hoplunnis,* p. 143.
aa. Dorsal and anal fins very low anteriorly, developed chiefly posteriorly; origin of dorsal just in advance of vent. *Neoconger,* p. 144.

38. Genus **Muræsox** McClelland.

Muræsox McClelland, Journ. Nat. Hist. Calcutta, IV, 1844, 408, (type *Muræsox tricuspidata* McClelland).

Body elongate; dorsal and anal fins well developed and connected with the caudal; origin of dorsal nearly over gill-opening; mouth large; the anterior teeth in each jaw canines, the rest of the teeth in each jaw in several series, one series near the middle enlarged and compressed, the others bluntish; middle series of teeth on shaft of vomer enlarged, and compressed, forming an arch; the anterior nostril with a tube.

KEY TO THE SPECIES.

a. Pectoral long, 2.1 to 2.3 in head; posterior nostril circular. *coniceps*, p. 142.

aa. Pectoral short, 2.8 to 3 in head; posterior nostril an oblique slit. *savanna*, p. 143.

84. Muræsox coniceps Jordan & Gilbert.

Muræsox coniceps Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 348 (Mazatlan); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 359; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 35 (Panama Bay).

Body moderately slender, compressed posteriorly; head and trunk rather short, 2.4 in total length; tail notably longer than rest of body, about 1.7 in total length; head 2.3 to 2.5 in head and trunk; snout long, tapering, moderately projecting, 4.3 to 4.6 in head; eye rather small, 10 to 11; mouth large, the gape reaching beyond the eye, 2.7 to 3 in head when measured from tip of lower jaw to angle of mouth; both jaws and vomer anteriorly with rather strong canines, the jaws laterally with 3 series of teeth, the 2 outer series small, bluntish, the inner series enlarged, compressed; vomer with an enlarged series of teeth on median line with a more or less distinct series of short blunt teeth on each side; anterior nostril wtih a short tube situated slightly above and behind lower anterior margin of snout, the posterior nostril round; gill-slits subinferior, rather large, well separated, the isthmus about half as broad as one slit; lateral line prominent, with large pores; the skin of upper parts and especially of the head rough in appearance, provided with innumerable pores and pits; origin of dorsal a little in advance of gill-opening, the fin confluent with the anal around the tail; pectoral fins long, 2.1 to 2.3 in head.

Color brownish, the back darkest, abdomen nearly pale; tubes of lateral line white, conspicuous; dorsal and anal fins margined with black anteriorly, becoming almost entirely black posteriorly; pectorals black.

This species is represented by 9 specimens, ranging in length from 675 to 900 mm. It is a common eel on the Pacific coast of Panama and may be seen in the Panama City market almost daily.

Known from Cape San Lucas to Panama. Our specimens are from Chame Point and the Panama City market.

85. Muræsox savanna (Cuvier).

Muræna savanna Cuvier, Règne Animal., Ed. II, II, 1829, 350 (Martinique).

Muræsox savanna Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 360.

Body slender, more or less compressed; head and trunk 2.3 in total length; the tail notably longer than the rest of body, 1.75 in total length; head 2.6 to 2.8 in head and trunk; snout long and tapering, prominently projecting, 4.7 to 4.8 in head; eye 9 to 11; mouth large, the gape reaching beyond eye, 2.8 to 2.9 in head when measured from tip of lower jaw to angle of mouth; teeth as in preceding species; anterior nostril ending in a short tube situated a little above and behind lower anterior margin of snout, the posterior nostril not far in front of eye, an oblique slit; pectoral fins moderate, 2.8 to 3 in tail. Other characters as in *M. coniceps*.

Three specimens of this species were preserved. It is much less common than its near relative of the Pacific coast, *M. coniceps,* from which it can scarcely be distinguished. The pectoral fins are, however, shorter in the specimens at hand and the posterior nostril appears as a slit in the present species, while it is round in *M. coniceps*.

Known from the West Indies to Brazil. Our specimens are all from Colon.

39. Genus **Hoplunnis** Kaup.

Hoplunnis Kaup, Abh. Naturw. Ver. Hamburg, IV, 1859 (1860), 19 (type *Hoplunnis schmidtii* Kaup).

The tail very long, about four times the rest of body; teeth in the jaws biserial; vomerine teeth long, pointed canines, uniserial; gill-openings wide.

86. Hoplunnis schmidtii Kaup.

Hoplunnis schmidtii Kaup, Abh. Naturw. Ver. Hamburg, IV, 1859

(1860), 19, Pl. II, fig. 4 (Puerto Cabello); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 361, Pl. LVIII, fig. 151.

This eel was not seen by us. It is known only from a single specimen from Puerto Cabello, Venezuela, and is very imperfectly described. The tail is said to be 4 times as long as the rest of the body, eye 3 in snout, and the posterior part of the vertical fins is black.

40. Genus **Neoconger** Girard.

Neoconger Girard, Proc. Ac. Nat. Sci. Phila., 1859, 171 (type *Neoconger mucronatus* Girard).

Body moderately elongated, not whip-like; tail not much longer than rest of body; mouth large, reaching beyond eye; maxillary teeth in several series; vomerine teeth forming a patch in front, uniserial behind; gill-opening rather large, vertical; vertical fins rudimentary, best developed posteriorly, confluent around the tail; origin of dorsal just in advance of vent; pectoral fins present.

One species has been recorded from the Pacific coast of Panama.

87. **Neoconger vermiformis** Gilbert.

Neoconger vermiformis Gilbert, Proc. U. S. Nat. Mus., 1890, 57 (Off Lower California, Albatross Sta. 3035); and p. 450 (Panama Bay, Albatross Sta. 2799); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 362; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 35.

"Pectoral well developed, 3½ to 4 in head. Snout anteriorly short, slightly projecting beyond mouth; mouth small, reaching slightly behind eye; teeth small, conical, uniserial in jaws, biserial anteriorly on the vomer, uniserial posteriorly; gill-slits vertical, longer than eye, a little longer than isthmus; dorsal beginning half length of head in advance of vent; body not very slender, its depth 2½ in head; head 3⅕ in trunk; cleft of mouth 3½ in head; tail usually a little longer than rest of body; tip of tongue slightly free. Color uniformly yellowish olive on body and fins, finely dotted with black. Lower California and Panama, in about 30 fathoms; several specimens known." (Jordan & Evermann.)

This species is known from Panama Bay, from specimens taken by the Albatross at Station 2799.

Family XXII. Myridæ.

The Worm Eels.

Body more or less worm-like; tongue more or less fully adnate to the floor of the mouth; posterior nostril situated either in the upper lip or very near it; vertical fins confluent around the tail.

A single genus is represented in the Panama collection.

41. Genus **Myrophis** Lütken.

Myrophis Lütken, Vidensk. Meddel. Nat. Foren. Kjøben., 1851, 1 (type *Myrophis punctatus* Lütken).

Body slender; vomer with teeth; origin of dorsal in advance of vent, the fin confluent with the anal around the tail; pectoral fins present but small.

Two closely related species occur in the Panama collection.

KEY TO THE SPECIES.

a. Teeth in 2 more or less distinct series on anterior part of jaws and vomer; snout rather broad, quite as broad as interorbital at anterior nostrils, its length 6.4 to 7 in head; back and sides with small and rather few punctulations. *vafer,* p. 145.

aa. Teeth on the upper jaw and vomer uniserial throughout; snout narrower, scarcely as broad as interorbital at anterior nostrils, its length 6.1 in head; back and sides with larger and more numerous punctulations. *punctatus,* p. 146.

88. **Myrophis vafer** Jordan & Gilbert.

Myrophis vafer Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 645 (Panama); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 372; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 35 (Panama).

Body very long and slender, more or less worm-like; head and trunk 2.5 to 3 in total length; tail much longer than head and trunk, 1.45 to 1.95 in total length; head rather long, 3.5 to 3.8 in head and trunk; depth 3.7 to 4.1 in head; snout rather broad, depressed, quite as broad at anterior nostrils as interorbital, projecting prominently beyond mouth, its length 6.4 to 7 in head; eye small, lateral, about 12 in head; mouth large, the gape reaching far beyond eye, 3.3 to 4.2 in head when measured from tip of lower jaw to angle of mouth;

teeth pointed, present on jaws and vomer, in 2 more or less distinct series on anterior part of jaws and vomer, in 1 series posteriorly; anterior nostril ending in a short downward projecting tube near tip of snout; origin of dorsal a little nearer gill-opening than vent, confluent with the anal around the tail; pectoral fins small, about as long as snout, the base of fins as broad as gill-slit.

Color brownish, back and sides with dark punctulations, lower parts plain.

There are 65 specimens, ranging from 60 to 238 mm. in length, at hand. This fish was reported common in the rock pools about Panama by Gilbert & Starks, but we obtained only 2 specimens there. The rest of our material was collected at Chame Point by Mr. Robert Tweedlie.

Known from Guaymas to Panama. The specimens in the present collection are from Chame Point and rocky tide pools at Panama City.

89. Myrophis punctatus Lütken.

Myrophis punctatus Lütken, Vidensk. Meddel. Nat. Foren. Kjøben., 1851, 1 (West Indies); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 371.

Body long, slender, worm-like; head and trunk 2.6 in total length; tail much longer than rest of body, 1.65 in total length; head rather long, 3.5 in head and trunk; depth 4.45 in head; snout rather long and narrow, scarcely as broad at anterior nostrils as interorbital, projecting prominently beyond mouth, its length 6.1 in head; eye very small, lateral, about 16 in head; mouth large, the gape reaching beyond eye, 4 in head when measured from tip of lower jaw to angle of mouth; teeth pointed, present on jaws and vomer, those in anterior part of lower jaw in 2 series, posteriorly in a single series, those on upper jaw and vomer uniserial throughout, the series anteriorly more or less irregular; anterior nostril ending in a short downward projecting tube near tip of snout; origin of dorsal a little nearer gill-opening than vent, confluent with the anal around the tail; pectoral fins small, scarcely as long as snout, the base of fins about as broad as gill-slit.

Color above brownish, back and sides with numerous, rather large, dusky punctulations; lower parts plain.

We have a single specimen, 150 mm. long, which was taken from deep mud several meters from the water's edge. This species appears to be very close to *M. vafer,* but it apparently differs slightly

in the longer, narrower snout; smaller eye; different arrangement of the teeth, there being but one series on anterior part of upper jaw and vomer, which have two series in *M. vafer;* and a slight difference in color, the punctulations being larger and more numerous in the present species.

Known from Texas to Brazil. Our specimen is from Mindi Cut.

Family XXIII. **Ophichthyidæ.**

Body slender; gill-openings well separated, lateral or subinferior; tongue present, usually adnate to the floor of the mouth; scales entirely wanting; the tail without the rudiments of a fin, projecting beyond the dorsal and anal fins, usually ending in a rather sharp, horny point. Anterior nostril placed in upper lip, tubular, the tube directed downward; mouth rather large, horizontal.

KEY TO THE GENERA.

a. Teeth conical, blunt or molar.
b. Origin of dorsal behind gill-opening. *Pisodonophis,* p. 147.
bb. Origin of dorsal in advance of gill-opening. *Myrichthys,* p. 149.
aa. Teeth all pointed.
c. Origin of dorsal in advance of gill-opening; pectoral fins rudimentary. *Bascanichthys,* p. 151.
cc. Origin of dorsal behind gill-opening; pectoral fins well developed. *Ophichthus,* p. 153.

42. Genus **Pisodonophis** Kaup.

Pisoodonophis Kaup, Cat. Apod. Fish Brit. Mus., 1856, 15 (type *Pisodonophis cancrivorus* Kaup).

This genus differs from *Myrichthys* in the backward insertion of the dorsal, which falls behind the gill-opening, and from *Ophichthus* in having blunt, molar teeth.

KEY TO THE SPECIES.

a. Pectoral fins poorly developed, appearing as dermal flaps behind gill-opening, the length shorter than width of base; origin of dorsal not far behind gill-opening, the distance about equal to length of snout; head and usually most of body with small round black spots. *daspilotus,* p. 148.

aa. Pectoral fins well developed, the length more than twice the base, equal to or longer than snout; origin of dorsal far behind gill-opening, the distance equal to head without snout; color uniform brownish, no spots anywhere.

cruentifer, p. 149.

90. Pisodonophis daspilotus Gilbert.

Pisoodonophis daspilotus Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2803 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 36, Pl. VII, fig. 12 (Panama).

Body long and slender, snake-like, the depth 24 to 30 in total length; head not greatly swollen, about as broad as deep, 8.5 to 10 in length; snout narrow, somewhat depressed, notably in advance of mouth, 5.3 to 7 in head; eye lateral, small, 13 to 16 in head; interorbital 7 to 9; mouth rather large, horizontal, the gape reaching far beyond eye, 3.2 to 4.2 in head when measured from tip of lower jaw to angle of mouth; teeth all broad and blunt, in bands on jaws and vomer; the teeth on anterior part of vomer the largest; vomerine band tapering posteriorly and extending beyond the angle of mouth; anterior nostril ending in a short, fringed tube on edge of the ventral surface of the overhanging snout; gill-openings moderate, the slit about 8 to 11 in head; vent close in front of anal; origin of dorsal rather variable, but always more or less behind gill-slit, the dorsal not confluent with the anal around tail; the tail without a fin, ending in a hard bony point, probably used in burrowing; anal fin low like the dorsal, its origin usually a little nearer tip of snout than tip of tail; pectoral fins very short, their base a little broader than gill-slits, also broader than length of fin, appearing more as a dermal flap behind gill-opening than as a true fin, the rays poorly differentiated.

Color grayish brown above; pale below; body usually with small round spots, smallest but most distinct on head, rarely present on distal part of tail, sometimes present only on head, but not entirely wanting on any of the specimens at hand; the fins paler than the body.

There are 50 specimens, ranging from 190 to 660 mm. in length, in the Panama collection. The largest specimen was taken with hook and line in brackish water at Corozal and the others were sent from Chame Point by Mr. Robert Tweedlie.

Known only from the Pacific coast of Panama, ascending brackish and fresh water streams.

91. Pisodonophis cruentifer Goode & Bean.

Pisoodonophis cruentifer Goode & Bean, Oceanic Ichth., 1895, 147, fig. 166 (Gulf Stream); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 377.

This is the only species of *Pisodonophis* known from the American waters of the Atlantic Ocean. Comparing this species with our specimens from the Pacific coast, we find that it may be readily distinguished by the much longer pectoral fins, their length being greater than twice the width of their base, or as long as or longer than snout. The dorsal fin is much more posteriorly inserted, the distance behind gill-opening being equal to the length of head without snout, and the color is uniform brownish, there being no dark spots present anywhere.

This species is not reported from as far south as the Isthmus, but it has been taken at various places in the Atlantic along the American shore and appears to be of uncertain distribution, and it may be expected on the coast of Panama.

43. Genus **Myrichthys** Girard.

Myrichthys Girard, Proc. Ac. Nat. Sci. Phila., 1859, 58 (type *Myrichthys tigrinus* Girard).

Body elongate, slender, but little compressed; dorsal and anal fins developed, and not extending on the end of the tail; origin of dorsal in front of gill-opening; pectoral fins present, small; teeth conical and blunt to molar-like; gill-openings in front of pectoral, small, with broad isthmus; anterior nostril with a tube on ventral edge of the overhanging snout.

KEY TO THE SPECIES.

a. Large round black spots on the body, without white centers. *tigrinus,* p. 149.

aa. Large black spots on the body, with distinct white centers about as large as the pupil. *oculatus,* p. 150.

92. Myrichthys tigrinus Girard.

Myrichthys tigrinus Girard, Proc. Ac. Nat. Sci. Phila., 1859, 58 (Adair Bay, Oregon); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 376; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 35 (Panama Bay).

Ophichthys xysturus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 346 (Mazatlan).

Pisodontophis xysturus Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 106.

Body long and slender, only slightly compressed, the depth 22 to 35 in total length; head somewhat swollen, not much deeper than broad, 11 to 12.3 in total length; snout narrow, somewhat depressed, notably in advance of mouth, 4.6 to 5.75 in head; eye lateral, 10 to 13; interorbital 6.35 to 9; mouth horizontal, the gape reaching beyond eye, 3 to 3.6 in head measured from tip of lower jaw to angle of mouth; teeth all short, coarse and blunt, not in a definite number of series, present on jaws and vomer, the vomerine band tapering posteriorly and reaching beyond angle of mouth; anterior nostril ending in a short, fringed tube situated on edge of ventral surface of the overhanging snout; gill-opening moderate, the slit about 8 to 11 in head; vent close in front of anal; origin of dorsal over nape, notably in advance of gill-opening, the fin rather high, not confluent with the anal around caudal; tail ending in a sharp, horny process, probably used for burrowing; anal lower than the dorsal, its origin notably nearer tip of snout than end of tail; pectoral fins small, their base scarcely broader than gill-slit, also broader than length of fin, appearing more like a dermal flap back of the gill-opening than as a true fin, the rays scarcely differentiated.

Color pale or brownish in spirits; sides with one, two or three rows of black spots, apparently depending upon age. Our smallest specimens, 170 mm. long, have only a single row of very large spots along the back; our medium sized specimens all have two rows and our largest specimens have a third row faintly visible. The black spots on head vary greatly in size and number; small on snout.

There are 31 specimens, ranging from 170 to 450 mm. in length, at hand. These were collected at Chame Point by Mr. Robert Tweedlie.

Known from Oregon (?) to Panama. Specimens at hand are from Chame Point.

93. Myrichthys oculatus (Kaup).

Pisoodonophis oculatus Kaup, Cat. Apod. Fish Brit. Mus., 1856, 22 (Curaçoa).

Ophisurus latimaculatus Poey, Repertorio, II, 1867, 252, Pl. III, fig. 1 (Cuba).

Ophichthys pardalis Günther, Cat. Fish. Brit. Mus., VIII, 1870, 82 (Cape Verde Islands; Canary Islands; West Indies).

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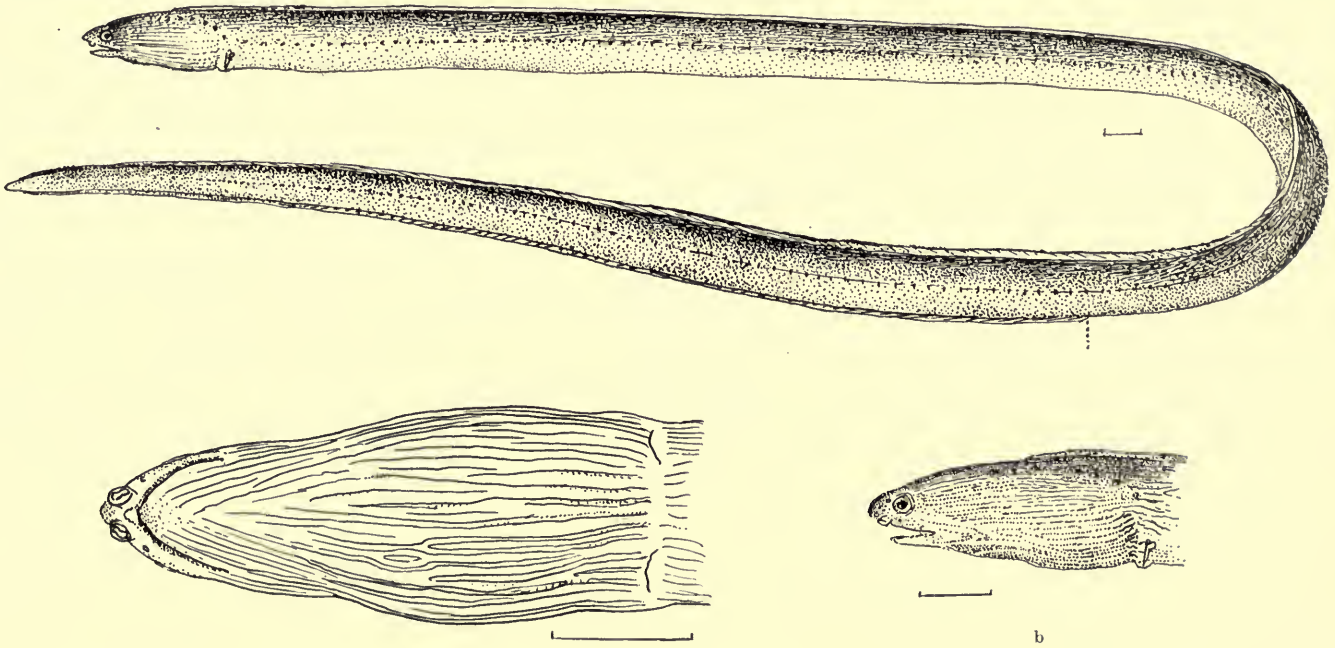

a b

BASCANICHTHYS PANAMENSIS sp. nov.
a. Ventral view of head, enlarged. b. Lateral view of head, enlarged.
Drawn from type 735 mm. in length.

Myrichthys oculatus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 376.

This fish was not seen on the coast of Panama, but it may be expected there. We have compared a specimen from Cuba with *M. tigrinus* from the Pacific coast of Panama. The two species appear to be closely related with respect to structure, but they may readily be distinguished by the color, as shown in the key to the species.

Known from Cuba to Brazil; also from the Cape Verde and Canary Islands.

44. Genus **Bascanichthys** Jordan & Davis.

Bascanichthys Jordan & Davis, Rept. U. S. Fish Comm., XVI, 1888 (1892), 621 (type *Cœcula bascanium* Jordan).

Body very elongate; head moderate; snout projecting beyond the mouth; teeth pointed, present on jaws and vomer, no canines; origin of dorsal over head, in advance of gill-opening; dorsal and anal low; pectoral fins present but rudimentary.

There are two species in the present collection which fall into this genus, both of which appear to be new. This genus has been reported only once from the Pacific, the record being based on a single specimen (*B. peninsulæ* Gilbert) from the Gulf of California. Two species are known from the Atlantic coast of the United States, but none are in our collections from the Atlantic coast of Panama.

KEY TO THE SPECIES.

a. Body moderately robust; the trunk long; the tail comparatively short, 1.3 to 1.4 in head and trunk; origin of dorsal a little nearer gill-opening than tip of snout; dorsal and anal fins low; pores of lateral line over opercular region in rather conspicuous white spots. *panamensis* sp. nov., p. 151.

aa. Body very slender; the trunk moderate; the tail very long, 1.05 to 1.2 in head and trunk; origin of dorsal a little nearer tip of snout than gill-opening; dorsal and anal fins somewhat higher; pores of lateral line over opercular region not in white spots. *cylindricus* sp. nov., p. 152.

94. Bascanichthys panamensis sp. nov. (Plate VII.)

Type No. 82211, U. S. N. M.; length 735 mm.; Chame Point, Panama.

Body moderately robust, scarcely compressed, the depth only slightly greater than the width; trunk long; the tail comparatively

short and robust, 1.3 to 1.4 in head and trunk; head 10.5 to 11.5 in trunk; snout pointed, much in advance of the mouth, 6.2 to 7.75 in head; eye small, a little less than half the snout; mouth moderate, horizontal, the gape reaching beyond eye, 4.45 to 5.15 in head when measured from tip of lower jaw to angle of mouth; teeth rather strong, pointed, recurved, those on jaws in a single series, the vomerine teeth in a single very irregular series or more or less definitely in 2 series; gill-slits subinferior, vertical, separated by a distance equal to the length of one slit, which is 8 to 10 in head; anterior nostril ending in a short tube on ventral surface of the overhanging snout; lateral line well developed, arched over the opercular region; vent close in front of anal; origin of dorsal over nape, a little nearer gill-opening than tip of snout, the fin low, placed in a groove, not confluent with the anal around the tail; tail ending in a sharp, horny point, probably used in burrowing; anal fin very low, lower than the dorsal, placed in a somewhat deeper groove than the dorsal; pectoral fins present but rudimentary, about as long as broad, not longer than the eye, inserted just behind upper part of gill-slit.

Color uniform bluish above, abruptly pale below lateral line; head mostly bluish black in adult, with less black in young, with a pale cross-bar just behind eyes and usually a second one a short distance behind it; each pore of lateral line over the opercular region with a small, round, white spot, these are usually also more or less distinctly visible along the sides; dorsal fin pale, appearing as a white line on the back.

This eel is represented by 115 specimens, ranging in length from 155 to 735 mm., all taken at Chame Point by Mr. Robert Tweedlie. Two of the specimens at hand appear to have had the upper jaw injured, probably bitten off, making it as short as the lower. In each case a lip was regenerated and normally formed tubes of the anterior nostrils appear at the lateral, anterior edge of the jaw.

95. Bascanichthys cylindricus sp. nov. (Plate VIII, fig. 1.)

Type No. 82210, U. S. N. M.; length 785 mm.; Chame Point, Panama.

Body very slender, slightly compressed, somewhat deeper than broad; trunk moderate; the tail very long and slender, 1.05 to 1.2 in trunk; head 10.5 to 11.2 in trunk and head; snout sharply pointed, projecting prominently beyond the mouth, 7.7 to 9.2 in head; eye very small, covered by membrane, less than half the length of snout; mouth moderate, horizontal, the gape reaching beyond eye, 4.9 to 5.75 in head when measured from tip of lower jaw to angle of mouth; teeth

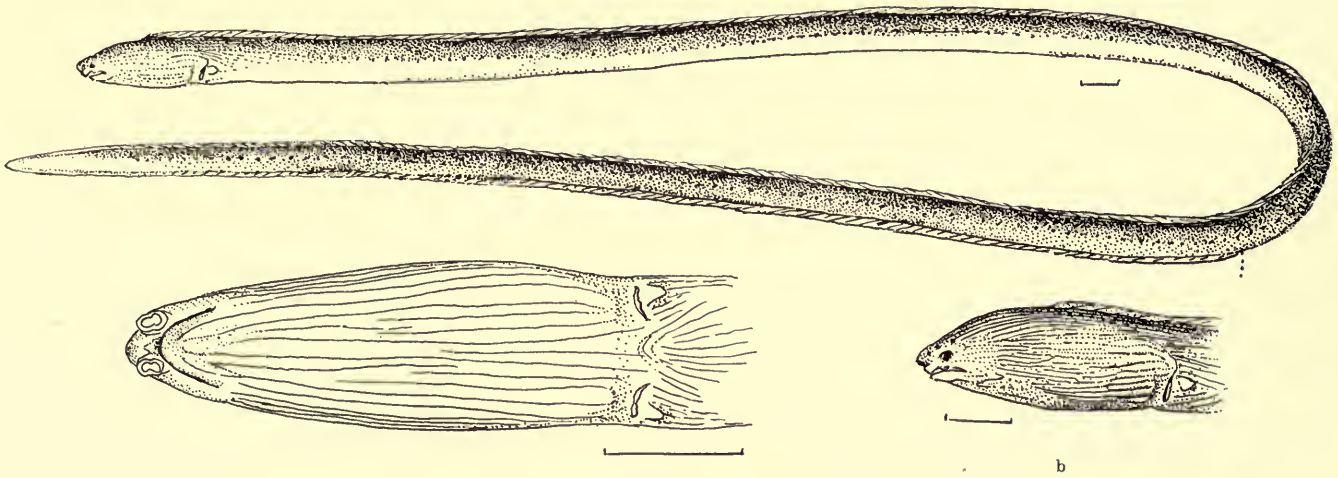

FIG. 1. BASCANICHTHYS CYLINDRICUS sp. nov.
a. Ventral view of head. b. Lateral view of head. Drawn from type 785 mm. in length.

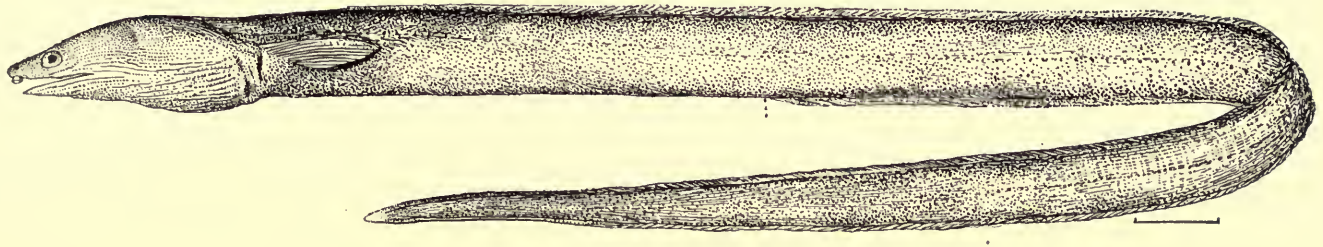

FIG. 2. OPHICHTHUS CHAMENSIS sp. nov.
Drawn from type 265 mm. in length.

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exactly as in the preceding species; gill-slits subinferior, vertical, separated by a distance equal to the length of one slit, which is 8.5 to 11 in head; anterior nostril ending in a short tube on ventral surface of snout; lateral line well developed, arched over the opercular region; vent close in front of anal; origin of dorsal over nape, a little nearer tip of snout than gill-opening, the fin somewhat higher than in the preceding species, placed in a groove, not confluent with the anal around the tail; tail ending in a sharp, horny point; anal fin of about the same height as the dorsal and similarly placed in a groove; pectoral fins present but rudimentary, slightly longer than broad, only a little longer than eye, inserted just behind upper part of gill-slit.

Color bluish black above, abruptly pale on the side below lateral line; no pale cross-bars on head, the ventral surface of head pale or only slightly dusky; the pores of lateral line over opercular region not in white spots, the pores on sides often in white dots. The dorsal fin is conspicuously paler than the back.

There are 10 specimens of this eel at hand, measuring from 235 to 865 mm. in length. These were collected at Chame Point by Mr. Robert Tweedlie. This species is rather closely related to the preceding, but is readily separable from it, especially if specimens of like sizes are compared. The body in the present species is more slender, the tail proportionately longer, the origin of the dorsal is a little farther forward, the dorsal and anal fins are a little higher and the rather conspicuous white spots surrounding the pores of the lateral line over the opercular region in the preceding species are wanting in the present form.

45. Genus **Ophichthus** Ahl.

Ophichthus Ahl, De Muræna et Ophichtho, 1787, 5 (type *Muræna ophis* Linnæus).

Cogrus Rafinesque, Caratteri, etc., 1810, 62 (type *Cogrus maculatus* Rafinesque).

Centrurophis (type *Centrurophis spadiceus* Kaup); *Pœcilocephalus* (type *Pœcilocephalus bonaparti* Kaup); *Microdonophis* (type *Microdonophis altipinnis* Kaup); *Cœcilophis* (type *Cœcilophis compar* Kaup); *Herpetoichthys* (type *Herpetoichthys ornatissimus* Kaup); *Elapsopsis* (type *Elapsopsis versicolor* Kaup); Kaup, Cat. Apod. Fish Brit. Mus., 1856, page numbers given in order like names above, 2, 5, 6, 6, 7, 9.

?Cryptopterus Kaup, Abh. Naturw. Ver. Hamburg, IV, 1859 (1860), 11 (type *Cryptopterus puncticeps* Kaup).

Uranichthys Poey, Repertorio, II, 1867, 256 (type *Muræna havannensis* Bloch & Schneider).

?Oxyodontichthys Poey, Anal. Soc. Españ. Hist. Nat., IX, 1880, 254 (type *Oxyodonichthys macrurus* Poey).

Ophichthys Bleeker and other authors, corrected spelling.

Body cylindrical; teeth pointed, no distinct canines; dorsal fin inserted behind the gill-opening; pectoral fin well developed.

KEY TO THE SPECIES.

a. Teeth in each jaw in 2 series; origin of dorsal in advance of end of pectoral.

b. Vomerine teeth in a single series.

c. The tail nearly twice as long as head and trunk, 1.5 in total length; coloration uniform, no spots on sides. *chamensis* sp. nov., p. 155.

cc. The tail notably less than twice the length of head and trunk, 1.8 to 1.85 in total length.

d. Sides with very large black spots, arranged in 2 or 3 rows; head with small dark spots; dorsal fin with a marginal series of black spots. *triserialis*, p. 155.

dd. Sides with a series of white spots and a white line across occiput. *ocellatus*, p. 156.

bb. Vomerine teeth in 2 series.

e. Head and trunk about half as long as tail; mouth large, the gape less than 2.65 in head.

f. Head long, 2.95 in head and trunk; mouth large, the cleft 2.25 in head; eye moderate, about half as long as snout, 12.5 in head; throat and pectoral fins pale. *magnioculis*, p. 157.

ff. Head somewhat shorter, 3.1 to 3.2 in head and trunk; mouth smaller, the cleft 2.5 to 2.6 in head; eye large, more than half the length of snout, 8.2 to 9.9 in head; throat and pectoral fins dusky. *zophochir*, p. 158.

ee. Head and trunk notably longer than half the tail; mouth somewhat smaller, the cleft 2.66 in head; eye large, about 1.5 in snout; pectorals dusky, dark along upper edge; lower jaw with dusky markings. *gomesii*, p. 159.

aa. Teeth in upper jaw in 2 or 3 series, those in lower jaw not quite in 1 series, some in front forming a second series; origin of dorsal behind end of pectorals. *puncticeps*, p. 160.

96. Ophichthus chamensis sp. nov. (Plate VIII, fig. 2.)

Type No. 82216, U. S. N. M.; length 265 mm.; Chame Point, Panama.

Body moderately slender, scarcely compressed; head and trunk short, about half as long as tail; the tail 1.5 in total length; head moderate, 2.9 to 3.5 in head and trunk; snout somewhat depressed, projecting beyond mouth, 5.5 to 6.25 in head; eye lateral, rather small, a little more than half the length of snout; interorbital transversely flat or a little concave, broader than eye in specimens 250 mm. in length; mouth rather large, horizontal, about half the length of gape behind the eye, 3.1 to 3.9 in head when measured from tip of lower jaw to angle of mouth; teeth in each jaw in 2 series; vomerine teeth in a slightly irregular series; gill-slits subinferior, vertical, separated by a distance a little greater than length of one slit, length of slit 8.35 to 9.7 in head; anterior nostril ending in a short tube on ventral surface of the overhanging snout; a dermal flap on lateral margin of upper jaw a little in front of posterior nostril; lateral line well developed, arched over the opercular region; vent close in front of anal; origin of dorsal over or slightly behind middle of pectorals, very low, not confluent with the anal around tail; caudal fin wanting, the tail ending in a sharp, horny point; anal fin low like the dorsal; pectoral fins large, inserted above and behind gill-slit, the length 2.25 to 2.4 in head.

Color uniform brownish above; pale below; no spots or blotches on sides; tip of snout and lower jaw dusky; a row of dark spots along margin of lower jaw.

This eel is represented by 13 specimens, ranging from 68 to 265 mm. in length, collected at Chame Point by Mr. Robert Tweedlie. This species falls into the group having the vomerine teeth in a single series and the teeth in each jaw in 2 series, but it appears to differ from any known species of that group in the very long tail and in the uniform coloration. It resembles *O. zophochir* very closely, apparently differing only in the uniserial teeth on the vomer.

97. Ophichthus triserialis (Kaup).

Murǣnopsis triserialis Kaup, Cat. Apod. Fish Brit. Mus., 1856, 12 (Pacific).

Herpetoichthys callisoma Abbott, Proc. Ac. Nat. Sci. Phila., 1860 475 (Locality unknown).

Ophisurus californiensis Garrett, Proc. Cal. Ac. Sci., III, 1863, 66 (Coast of Lower California).

Ophichthys triserialis Günther, Cat. Fish. Brit. Mus., VIII, 1870, 58.

Ophichthus rugifer Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 155 (Charles Island, Galapagos).

Ophichthus triserialis Jordan & Evermann, Bull. U. S. Mus., XLVII, 1896, 384.

Body cylindrical; the trunk rather long; the tail moderate, exceeding the length of the rest of the body by length of head, 1.8 in total length; head long, flat above, 3.8 in head and trunk; snout depressed, projecting prominently beyond the mouth, 4.95 in head; eye moderate, lateral, 3.8 in head; mouth large, the gape reaching far beyond eye, 2.7 in head when measured from tip of lower jaw to angle of mouth; teeth small, pointed, subequal, in 2 series in each jaw, vomerine teeth in a single series; gill-slits nearly vertical, well separated, the isthmus as broad as gill-slits, the slits nearly as long as snout; anterior nostril with a rather prominent tube on lower edge of the overhanging snout; lateral line well developed; origin of dorsal over about middle of pectorals, the fin quite low, ending a short distance in advance of tip of tail; tail with a sharp, horny point; anal fin low, similar to dorsal; pectoral fins long and narrow, inserted above and behind gill-opening, 2.8 in head.

Color light brown; a row of large black spots along side on and above lateral line; a row of smaller spots along back on each side of dorsal, usually although not always alternating with the large spots; a third row of moderately large, black spots below lateral line, present anteriorly but disappearing posteriorly; head with many small black spots. Dorsal fin with a marginal series of black spots; anal fin pale or with dusky punctulations; pectoral fins with many dusky punctulations, those on base of fin forming indefinite dark spots.

This fish is not present in the Panama collections, nor does there appear to be a Panama record. It is here included because of its range of distribution, which brings it within the scope of the present work. The above description is based on a specimen 700 mm. in length taken at Cape San Lucas.

Known from Lower California to the Galapagos Islands.

98. Ophichthus ocellatus (Le Sueur).

Muræophis ocellata Le Sueur, Journ. Ac. Nat. Sci. Phila., V, 1825, 108, Pl. IV, fig. 3 (South America).

Ophisurus remiger Valenciennes, in D'Orbigny, Voy. Amér. Mérid., Poiss., 1839, Pl. XII, fig. 2.

Ophichthys ocellatus Günther, Cat. Fish. Brit. Mus., VIII, 1870, 68.

Herpetoichthys ocellatus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 155.

Ophichthus ocellatus Jordan & Evermann, Bull. U. S. Nat. Mus. XLVII, 1896, 383.

Body slender; the tail longer than the rest of body, 1.85 in total length; head 3.8 in head and trunk; depth 12.5; snout pointed, projecting beyond the mouth, its length 5.1 in head; eye 8.7; interorbital 6.6; mouth large, the gape extending far beyond eye, 2.4 in head; teeth all pointed, subequal, in 2 series in each jaw, vomerine teeth anteriorly in a patch, those on shaft of vomer uniserial; anterior nostril with a tube, the posterior nostril in margin of upper lip; gill-opening nearly vertical, its width about twice the base of pectoral; origin of dorsal over middle of pectorals, the distance from tip of snout 2.9 in head and trunk; pectoral fins 2.5 in head.

Color light brown above; nearly white below, sides with a series of about 17 white spots of about the size of eye; a white line across occiput, in front of which are 2 short lines on each side of head, below these on each side is a right angle formed by 2 short lines.

This fish was not taken by us. It is here described from 2 specimens, one from Florida, U. S. N. M. No. 22289, and the other from South Carolina, U. S. N. M. No. 25585, respectively 570 and 462 mm. in length.

Known from South Carolina to Brazil.

99. Ophichthus magnioculis (Kaup).

Scytalophis magnioculis Kaup, Cat. Apod. Fish Brit. Mus., 1856, 13 fig. 7 (St. Croix; Brazil).

Ophichthys magnoculus Günther, Cat. Fish. Brit. Mus., VIII, 1870, 59.

Ophichthus magnioculis Jordan & Davis, Rept. U. S. Fish. Comm., XVI, 1888 (1892), 633; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 385 (Aspinwall=Colon.)

Body moderately robust; the head and trunk short, scarcely half as long as tail; the tail very long, 1.45 in total length; head long, slightly depressed, 2.95 in head and trunk; snout long, rather broad, notably in advance of mouth, 5.1 in head; eye lateral, about half as long as snout, 12.5 in head; mouth large, the gape reaching far beyond eye, the distance being equal to twice the diameter of eye, 2.25 in head when measured from tip of lower jaw to angle of mouth; teeth all small, pointed, in 2 distinct series on each jaw and vomer; anterior nostril ending in a rather prominent tube on outer ventral edge of snout, just in front of tip of lower jaw, the tube with a short

barbel on inner edge; origin of the dorsal over middle of pectorals, the fin low; tail ending in a blunt, horny point; anal fin low like the dorsal; pectoral fins long and narrow, inserted above and behind gill-opening, 2.25 in head.

Color brownish, paler below; the dorsal and anal posteriorly, at least, margined with black; the mandible with a series of black dots on each side behind lip.

This eel was not taken by us. It is here described from a single specimen, U. S. N. M. No. 38522, 515 mm. in length, taken at "Aspinwall" by the Albatross. Aspinwall is now Colon, the largest city on the Atlantic coast of Panama. This species is very close to *O. zophochir,* if actually distinct. The head in the present species appears to be slightly longer, the mouth a little larger, the eye smaller and the color differs slightly, the throat and pectoral fins being pale instead of dusky. These differences are small and might well occur within the range of variation of a species, and we should not hesitate to unite the two species, were they not from the opposite shores.

Known from the West Indies to Brazil.

100. Ophichthus zophochir (Jordan & Gilbert).

Ophichthys zophochir Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 347 (Mazatlan).

Ophichthus zophochir Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 385; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 37 (Panama Bay).

Body slender; the trunk short, head and trunk only a little more than half as long as tail; the tail long, 1.55 to 1.6 in total length; head rather long, 3.1 to 3.2 in head and trunk; snout somewhat depressed, projecting prominently beyond mouth, 5.3 in head; eye lateral, about 1.75 in snout, 8.2 to 9.9 in head; mouth large, the gape reaching behind eye a distance equal to 1.25 diameter of eye, its length 2.5 to 2.6 in head when measured from tip of lower jaw to angle of mouth; teeth in the jaws small, subequal, in 2 well separated series on each jaw and on vomer; gill-slits vertical, well separated, the isthmus nearly as broad as gill-slit; lateral line well developed, arched over the opercular region; anterior nostril ending in a short tube on lower lateral edge of snout just in front of tip of lower jaw; origin of dorsal over middle of pectorals, the fin very low; tail ending in a short horny point; anal fin low, similar to dorsal; pectoral fins rather long and narrow, inserted behind and above gill-opening, 2.25 to 2.45 in head.

Color brown above; yellowish below; opercular regions, lower jaw, throat and pectoral fins dusky; dorsal and anal fins black edged.

This eel is not in our collection, but it is recorded from Panama by Gilbert & Starks, who base the record on a single specimen 329 mm. in length. The above description is based on 2 type specimens from Mazatlan.

Known from Guaymas to Panama.

101. Ophichthus gomesii (Castelnau).

Ophisurus gomesii Castelnau, Anim. Nouv. Rares Amér. Sud, 1855, 84, Pl. XLIV, fig. 2 (Rio Janeiro).

Ophisurus chrysops Poey, Memorias, II, 1861, 321 (Havana).

Ophichthys brachyurus Poey, Syn. Pisc. Cub., 1868, 426 (Havana).

Ophichthys gomesii Günther, Cat. Fish. Brit. Mus., VIII, 1870, 60.

Oxyodontichthys limbatus Poey, Anal. Soc. Españ. Hist. Nat., IX, 1880, 254 (Havana; name substituted for *brachyurus*).

?Oxyodontichthys macrurus Poey, Anal. Soc. Españ. Hist. Nat., IX, 1880, 254 (Havana).

Ophichthys chrysops Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 898.

Ophichthus gomesii Jordan & Davis, Rept. U. S. Fish. Comm., XVI, 1888 (1892), 632; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 384.

"Vomerine teeth biserial throughout; teeth in both jaws biserial, subequal, no canines; pectoral 2⅕ to 2⅖ in head, about as long as cleft of mouth, which is 2⅔ in head. Body terete; the head rather short, about 2⅔ (2½ to 3) in trunk; the head and trunk 1 5/7 (1½ *"chrysops"* to 1 9/10 *"macrurus"*) in the tail; snout rather short, pointed; interorbital space broad, equal to eye, which is about 1½ in snout; nasal tubes short; dorsal inserted behind middle of pectoral; diameter of gill-opening equal to eye, 1½ in the isthmus, 3 in the pectoral.

"Olive brown above, the coloration caused by innumerable brown points on a yellowish ground; light yellow below; pectoral dusky, dark along the upper edge; lower jaw with dusky markings; dorsal and anal fin translucent, with dark margins; pores on jaws and head conspicuous." (Jordan & Evermann.)

This species, which is recorded from South Carolina to Rio Janeiro, was not seen by us on the coast of Panama. It is said to be a common species at Cuba and the Florida Keys. It appears to be very closely related to *O. magnioculis* and *O. zophochir*.

102. Ophichthus puncticeps (Kaup).

Cryptopterus puncticeps Kaup, Abh. Naturw. Ver. Hamburg, IV, 1859 (1860), 11, Pl. I, fig. 2 (Puerto Cabello).

Ophichthus puncticeps Günther, Cat. Fish. Brit. Mus., VIII, 1870, 60.

Ophichthys puncticeps Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 382.

This eel was not seen by us. It is described as having the teeth in the upper jaw in 2 or 3 series and the teeth in the lower jaw not quite in one series, some in front forming a second series. The tail is longer than the rest of the body, being 3/5 of the total length; the eye is of moderate size, and the mouth of moderate width. The origin of the dorsal falls behind the end of the pectoral, and the pectoral fins are well developed. The color is uniform.

This fish appears to be known only from Puerto Cabello.

Family XXIV. Muræniдæ.

The Morays.

Body moderately robust; head conic; mouth large; the occipital region elevated through the development of strong muscles; teeth strong, sharp or blunt; gill-openings small, lateral; skin thick leathery, extending on the dorsal and anal fins which are confluent around the tail; pectoral fins entirely wanting.

The morays inhabit the warmer seas, usually living among the corals and rocks. Some of them reach a large size and are voracious and pugnacious.

KEY TO THE GENERA.

a. Origin of the dorsal over or behind the gill-opening. *Rabula*, p. 161.

aa. Origin of the dorsal in advance of the gill-opening.

b. Teeth nearly all pointed, the anterior ones well developed canines.

c. The anterior nostril with a short tube, the posterior nostril without a tube. *Gymnothorax*, p. 161.

cc. Both nostrils with a distinct tube. *Muræna*, p. 168.

bb. Teeth nearly all blunt, no differentiated canines. *Echidna*, p. 170.

46. Genus **Rabula** Jordan & Davis.

Rabula Jordan & Davis, Rept. U. S. Fish Comm., XVI, 1888 (1892), 590 (type *Muræna aquæ-dulcis* Cope).

Form and dentition essentially the same as in *Gymnothorax*, differing in having the origin of the dorsal over or behind gill-openings. We did not obtain any specimens of this genus. Below, however, is given an account of one species which has been taken in Panama.

103. Rabula panamensis (Steindachner).

Muræna panamensis Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXIV) Ichth. Beitr., V, 1876, 19 (Panama); Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Flamenco Island, Panama Bay).

Sidera panamensis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 623 (Pearl Islands).

Rabula panamensis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 391 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 37.

Body compressed; the tail longer than rest of body, about 1.85 in total length; head 3.57 in head and trunk; snout pointed, projecting slightly, 5.45 in head; eye about 1.33 in snout, 9.4 in head; mouth large, reaching beyond eye; the gape 2.25 in head when measured from tip of lower jaw to angle of mouth; teeth anteriorly canine-like, the lower jaw anteriorly with 2 series, only 1 series posteriorly, upper jaw with 2 series, vomerine teeth small and pointed, some of the teeth finely serrate at base of posterior margin; the anterior nostril only with a very short tube; gill-opening very small; origin of dorsal slightly behind gill-opening; the dorsal and anal fins low, of about equal height, confluent around the tail.

Body uniform brownish; the eye surrounded by black; the pores on jaws whitish.

This species was not taken by us, but the type is from Panama; a second specimen is recorded from the Pearl Islands by Jordan & Gilbert; and another specimen is reported from Flamenco Island by Boulenger. A rare species. We have examined a poorly preserved specimen, U. S. N. M. No. 43594, labeled "South America."

Apparently recorded only from Panama.

47. Genus **Gymnothorax** Bloch.

Gymnothorax Bloch, Naturg. Ausl. Fische, IX, 1795, 83 (type *Gymnothorax muræna* Bloch=*Muræna helena* Linnæus).

Lycodontis McClelland, Journ. Nat. Hist. Calcutta, V, 1844, 173 (type *Lycodontis literata* McClelland).

Body elongate, moderately compressed; dorsal and anal fins developed, the origin of the former before gill-openings; caudal fin present; confluent with dorsal and anal; anterior nostril only with a tube; posterior nostril over anterior portion of eye, its margin slightly raised in some species; teeth mostly pointed, the anterior ones in both jaws canines, some being depressible; teeth on shaft of vomer usually in one series; no pectoral fins; gill-openings lateral, small, nearly horizontal.

KEY TO THE SPECIES*.

a. Teeth all entire, without serrations.
b. Color brownish, the markings, if any, are blackish, not whitish or yellowish.
c. Body plain dark brown, lower parts somewhat paler; no spots; the fins with or without pale margins; teeth on anterior part of jaws more or less distinctly in 2 series, about 20 teeth on side of lower jaw; tail longer than rest of body, about 1.75 in total length. *funebris*, p. 163.
cc. Body brownish, finely freckled or mottled with darker; teeth all uniserial.
d. Body mottled with dark brown or slightly purplish spots; lower jaw with about 22 teeth on side; tail longer than rest of body by about .66 the length of head. *vicinus*, p. 164.
dd. Body finely freckled, but without distinct spots; lower jaw with about 13 teeth on side; tail about equal in length to the rest of the body. *verrilli*, p. 165.
bb. Color brownish, mottled, reticulated or speckled with white or light yellow.
e. Body with small pale spots or specks; snout long, about 4.5 in head. *dovii*, p. 165.
ee. Body everywhere mottled and reticulated with pale or light yellow, varying among individuals; snout short, about 6 in head. *moringa*, p. 166.
aa. Teeth serrate, at least at base of posterior margin.

*Too much dependence should not be placed on this key, as we have been unable to examine several of the species mentioned, and they are very imperfectly described. The characters used, therefore, have not been verified in all of the species.

f. Body everywhere, except on chin and abdomen, with pale yellowish round spots, smallest and most numerous on head; fins mostly black, with a series of very large spots cutting the margins and placed at regular intervals; eye conspicuously surrounded by black. *jordani*, p. 167.

ff. Body with irregular light yellowish spots, variable in size and number, often making the ground color appear as brown reticulations; dorsal fin with large black spots, sometimes running together and forming a black band; anal with a dark edge. *ocellatus*, p. 168.

104. Gymnothorax funebris Ranzani.

Gymnothorax funebris Ranzani, Novi Comment. Ac. Sci. Inst. Bonon., IV, 1840, 76 (Brazil).

Muræna lineopinnis Richardson, Voy. Erebus & Terror, 1844, 89 (Puerto Cabello).

Muræna infernalis Poey, Memorias, II, 1861, 347, 354 (Cuba).

Muræna erebus Poey, Memorias, II, 1861, 426 (Cuba).

Thyrsoidea concolor Abbott, Proc. Ac. Nat. Sci. Phila., 1860, 479 (Vera Cruz).

Sidera funebris Bean & Dresel, Proc. U. S. Nat. Mus., 1885, 169.

Lycodontis funebris Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 396.

Body not very slender, compressed; head and trunk shorter than tail, 2.1 to 2.3 in total length; the tail tapering, 1.75 to 1.9 in total length; head 2.9 to 3:5 in head and trunk; depth 6 to 7.5; snout long, pointed, only slightly projecting, 5 to 6 in head; eye 9 to 12; mouth large, the gape reaching far beyond eye, 2.1 to 2.5 in head when measured from tip of lower jaw to angle of mouth; teeth all pointed, those on anterior part of jaws more or less distinctly in 2 series; enlarged canines; posteriorly in a single close set series, directed backward, about 20 on side in lower jaw; vomer with 2 or 3 large teeth anteriorly, an interval without teeth, the teeth on shaft of vomer small, in a single more or less irregular series or in 2 series; gill-opening a small slit, not much longer than eye; origin of dorsal over nape, slightly nearer gill-opening than angle of mouth, the fin confluent with the anal around the tail.

Color plain dark brown, lower parts somewhat paler; the fins rather darker than the body, with or without pale margins. In a few of our specimens the anal and the posterior part of the dorsal are prominently

edged with white, in another specimen only the posterior part of both fins is feebly edged with white; the dorsal and anal usually with more or less distinct dark longitudinal stripes.

Nine specimens of this species were preserved, ranging in length from 385 to 665 mm. It is not infrequently seen in the Colon fish market, being of some value as food. There appears to be considerable variation with respect to the arrangement of the vomerine teeth, some specimens having a single, fairly straight series on the shaft, others having an irregular series and still others with 2 distinct series. There is no indication that these differences are due to age, but they appear as mere variations among specimens. There is also some variation with respect to the color of the fins, as has been pointed out under the description of the color.

Known from Florida to Brazil. Also recorded from the Cape Verde Islands. Our specimens are from Mindi, Colon and Porto Bello.

105. Gymnothorax vicinus (Castelnau).

Murenophis vicina Castelnau, Anim. Nouv. Rares Amér. Sud, 1855, 81, Pl. XLII, fig. 4 (Bahia).

Gymnothorax versipunctatus Poey, Enumeratio, 1875, 156 (Cuba).

Muræna vicina Günther, Cat. Fish. Brit. Mus., VIII, 1870, 121.

Gymnothorax vicinus Jordan, Proc. U. S. Nat. Mus., 1890, 315.

Lycodontis vicinus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 394.

Body moderately slender; the tail longer than the rest of the body by about .66 the length of head; head long, about 2 in trunk; snout long and narrow; eye large, 2 in snout; mouth large, the gape reaching far beyond eye, the jaws straight and the mouth capable of being completely closed; teeth all entire, uniserial; canines well developed on anterior part of jaws; lower jaw with about 22 teeth at side; gill-opening narrower than eye; origin of dorsal about an eye's diameter in advance of gill-opening.

Color brown, finely mottled with darker brown or purplish; angle of mouth dusky; black spot at gill-opening faint or wanting; dorsal with a dusky edge, the fin with dark longitudinal stripes; anal edged with white.

This eel is known from Cuba to Brazil and is also recorded from Africa. It does not occur in the Panama collection and was not seen by us. The above description is compiled from published records.

106. Gymnothorax verrilli (Jordan & Gilbert).

Sidera verrilli Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 623 (Panama).

Gymnothorax verrilli Jordan & Davis, Rept. U. S. Fish Comm., XVI, 1888 (1892), 599.

Lycodontis verrilli Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 393.

Head and trunk about equal to length of tail; head 3.25 in trunk; eye near angle of mouth, 3 in snout; teeth all entire, uniserial, about 13 on side of lower jaw; vomerine teeth small, in a short row posteriorly.

Color light chestnut brown, finely freckled, but without distinct spots; dorsal with a conspicuous edge of blackish, the margin narrowly white; anal edged with white.

The type and only specimen known was taken at Panama in 1866 by Prof. H. F. Bradley. This specimen was not examined by us. The above description is compiled from published accounts.

107. Gymnothorax dovii (Günther).

Muræna dovii Günther, Cat. Fish. Brit. Mus., VIII, 1870, 103 (Panama).

Muræna pintita Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 346 (Mazatlan).

Sidera dovii Jordan & Gilbert, Proc. U. S. Nat. Mus., 1883, 209

Gymnothorax dovii Jordan & Davis, Rept. U. S. Fish Comm., XVI, 1888 (1892), 604.

Lycodontis dovii Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 397; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 37 (Panama).

Body not very slender, compressed; head and trunk shorter than tail, 2.15 to 2.4 in total length; tail tapering, 1.7 to 1.85 in total length; head 3.3 to 3.6 in head and trunk; depth 5.7 to 5.9; snout pointed, scarcely projecting, 4.5 to 4.75 in head; eye 10.2 to 13.6; mouth large, the gape reaching far beyond eye, 2.06 to 2.33 in head when measured from tip of lower jaw to angle of mouth; teeth on the dentary bones all in single series; the teeth on anterior part of jaws enlarged canines; vomer anteriorly with 3 very large depressible teeth, the largest teeth present; shaft of vomer with small teeth; a rather long space between the large and small teeth toothless; gill-opening a

slit, slightly exceeding the length of eye; origin or dorsal over the nape, a little nearer gill-opening than angle of mouth, the fin confluent with the anal around the tail.

Color brown; the body with numerous small pale spots, which in our specimens are mere specks, wanting on abdomen; fins of the same color as the body, also with white dots.

Only two specimens of this species, 860 and 465 mm. long, were obtained. One of these was purchased in the Panama City market and the other was taken from a rocky pool at Balboa.

Known from the Gulf of California to the Galapagos and Easter islands. Our specimens are from Balboa and Panama.

108. Gymnothorax moringa (Cuvier).

Muræna moringa Cuvier, Règne Animal, Ed. II, II, 1829, 352 (Bahamas, after Catesby).

Gymnothorax rostratus Agassiz, in Spix, Pisc. Brasil., 1831, 91, Pl. 50a (Brazil).

Muræna moringua, Richardson, Voy. Erebus & Terror, 1844, 89 (Jamaica).

Muræna punctata Gronow, Cat. Fish, 1854, 18 (North America).

Murenophis curvilineata Castelnau, Animal. Nouv. Rares Amér. Sud, 1855, 81, Pl. XLII, fig. 2 (Rio Janeiro).

Murenophis caramura Castelnau, Anim. Nouv. Rares Amér. Sud, 1855, 82, Pl. XLIII, fig. 1 (Bahia).

Gymnothorax flavoscriptus Poey, Enumeratio, 1875, 158 (Cuba).

Gymnothorax picturatus Poey, Anal. Soc. Españ. Hist. Nat., IX, 1880, 257 (Cuba).

Sidera moringa Jordan, Proc. U. S. Nat. Mus., 1884, 111.

Gymnothorax moringa Jordan & Davis, Rept. U. S. Fish. Comm., XVI, 1888 (1892), 601.

Lycodontis moringa Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 395.

Tail usually a little longer than head and trunk; head 2 to 3.2 in trunk; snout 6 in head; eye large, 1.5 to 2 in snout; cleft of mouth 2.25 to 2.5 in head; teeth uniserial, unequal in size; those in front of jaws long, slender canines; the lateral teeth directed backward; vomer with 2 or 3 long depressible teeth in front and a row of smaller teeth posteriorly; origin of dorsal about an eye's diameter in advance of gill-opening.

Color in alcohol dark brown, everywhere mottled and reticulated with pale or light yellow; ventral surface of the head pale, with a

few brown spots; fins colored like the body; the anal and the dorsal usually posteriorly bordered with white. The color in this species is subject to considerable variation. On some specimens the light spots have so run together as to leave none of the usual ground color, or just a trace of it showing as a few indefinite, irregular markings.

This fish is known from Florida to Brazil and it is also recorded from St. Helena. It was not taken by us, and is not as yet recorded from the Atlantic coast of Panama. The above description is compiled from published accounts.

109. Gymnothorax jordani (Evermann & Marsh).

Lycodontis jordani Evermann & Marsh, Rept. U. S. Fish Comm., 1899 (1900), 352, and Bull. U. S. Fish Comm., XX, Pt. I, 1900 (1902), 78, Pl. II (Mayaguez, Porto Rico).

Body rather slender; head and body shorter than tail; 2.25 in total length; tail long, tapering, slender posteriorly, 1.8 in total length; head 3.06 in head and trunk; snout moderate, slightly projecting, 4.62 in head; eye 7.5; mouth large, the gape reaching far beyond the eye, 2.5 in head measured from tip of lower jaw to angle of mouth; teeth all in single series, the anterior ones in the jaws enlarged, canines; the lateral teeth moderate, not very close set, directed backward, serrate at base at least on posterior margin; vomer anteriorly without teeth, the shaft with a single series of blunt teeth; gill-opening a small slit, scarcely as long as eye; origin of dorsal about an eye's diameter in advance of gill-opening, the fin notably higher than the anal and confluent with it around the tail.

Color brown above; somewhat paler below; body everywhere, except on chin and abdomen, with pale yellowish spots, smallest and most numerous on head, largest on distal part of tail where they are not much smaller than eye; eye conspicuously surrounded by black; the fins darker than the body, with large, yellowish spots at regular intervals, much larger than those on the body.

A single specimen 310 mm. in length was taken. We have compared it with the type of the species with which it appears to agree quite well. The teeth were, however, erroneously described as being smooth, whereas they are distinctly serrate at least on posterior margin near the base. Its relationship therefore is with *G. ocellatus*.

Previously known only from the type from Porto Rico. Our specimen is from Fox Bay, Colon.

110. Gymnothorax ocellatus Agassiz.

Gymnothorax ocellatus Agassiz, in Spix, Pisc. Brasil., 1831, 91, Pl. Lb (Brazil).

Priodonophis ocellatus Poey, Syn. Pisc. Cub., 1868, 427.

Muræna ocellata Günther, Cat. Fish. Brit. Mus., VIII, 1870, 102.

Lycodontis ocellatus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 399.

Tail a little longer than rest of body; head 2 to 2.25 in trunk, 3.5 to 4.5 in tail; snout rather short and thick; eye rather small, 1.25 to 1.75 in snout; mouth large, capable of being closed; the gape 2.5 to 3 in head; teeth all uniserial in the jaws, rather large and strong, the posterior edge of the larger teeth serrate; vomer with a few small teeth or none; gill-opening narrow.

Color brown above, lighter below, with irregular light yellowish spots, variable in size and sometimes very thickly placed, making the ground work appear as brown reticulations; dorsal fin with large black spots on the edge, these often running together and forming a black band; anal fin with a dark edge.

This species is known from Florida to Uruguay. It was not seen on the Atlantic coast of Panama, and is not recorded from there. Its distribution, however, brings it within the scope of the present work. The above description is compiled from published accounts.

48. Genus **Muræna** Linnæus.

Muræna Linnæus, Syst. Nat., Ed. X, 1758, 244 (type *Muræna helena* Linnæus).

Murænophis Cuvier, Tab. Èlément., 1798, 329 (type *Muræna helena* Linnæus).

Limamuræna Kaup, Cat. Apod. Fish Brit. Mus., 1856, 95 (type *Limamuræna guttata* Kaup).

This species differs from *Gymnothorax* and the other genera of the family in the presence of 2 pairs of nasal barbels; teeth pointed.

KEY TO THE SPECIES.

a. Body with well separated round yellowish spots which are more or less distinctly surrounded with black. *lentiginosa,* p. 169.

aa. Body everywhere profusely spotted with irregular white spots, posteriorly often more or less united, forming reticulations, not surrounded with black. *clepsydra,* p. 169.

111. Muræna lentiginosa Jenyns.

Muræna lentiginosa Jenyns, Voy. Beagle, Zoöl., 1842, 143 (Galapagos Islands); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 402; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 39.

Muræna pinta Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 345 (Mazatlan), and 1882, 371 (Panama).

Body rather slender; the tail prominently compressed, longer than rest of body, about 1.75 in total length; head about 3.3 in head and trunk; snout pointed, slightly projecting, 5.3 in head; eye moderate, 1.75 in snout; mouth large, reaching far beyond eye; the gape 2.25 in head when measured from tip of lower jaw to angle of mouth; teeth all pointed, those in upper jaw in 2 series in young (nearly or quite uniserial in adult), the inner teeth depressible; mandible and vomer each with a single series of teeth; young with 2 or 3 long canines on anterior part of vomer (apparently lost in adult); shaft of vomer with a series of small, rather close set teeth; gill-opening an oblique slit, about as long as eye; origin of dorsal over the head, about equidistant from eye and gill-slit; the dorsal much higher than the anal and confluent with it around the tail.

Color brownish, with yellowish spots, more or less distinctly edged with black; gill-opening surrounded by black; fins colored and spotted like the body.

This eel was not taken by us. The Panama record is based on a single specimen, 178 mm. long, taken by Rev. Rowell during the seventies of the past century. It has not been seen there by other collectors. The above description is based on Rev. Rowell's specimen and a specimen 515 mm. in length from Colima.

Known from the Gulf of California to the Galapagos Islands.

112. Muræna clepsydra Gilbert.

Muræna clepsydra Gilbert, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2805 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 38, Pl. VII, fig. 13 (Panama); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 81 (Panama Bay).

Body compressed, rather robust, growing much more so with age; tail longer than rest of body, 1.7 to 1.85 in total length; head 2.9 to 3.1 in head and trunk; depth at vent 2 in head in specimens 385 mm. long, 1.45 in head in specimens 750 mm. in length; snout pointed, projecting moderately, 5 to 5.8 in head; eye rather small, 2 to 2.7 in

snout; mouth large, the gape reaching far beyond eye, 2 to 2.6 in head when measured from tip of lower jaw to angle of mouth; teeth all pointed, uniserial, the jaw teeth slightly compressed at base, directed backward, the anterior teeth longest; vomer with 1 or 2 large canines (none in our largest specimen), the shaft with a single series of small teeth; gill-opening an oblique slit about as long as eye; origin of dorsal over head, about equidistant from eye and gill-slit; dorsal and anal very fleshy, confluent around the tail.

Color dark brown, lighter below; everywhere with irregular white spots, largest posteriorly, small on head, those posteriorly often more or less united, forming reticulations; the base of folds on chin each with a dark line; angle of mouth with a black spot, preceded by a pale spot on mandible; a large elliptical black spot surrounding the gill-opening; the fins of the same color as the body and spotted like it.

This eel is represented by 5 specimens, ranging in length from 385 to 750 mm. The species is remarkable because of the rapid increase in robustness with age. It is a rather common species on the Pacific coast of Panama where it lives among the rocks. It takes the hook readily, and it is a very vigorous fighter. One large individual was captured after it had broken the line twice and had the third hook lodged in its œsophagus. The pain from these wounds did not appear to deter it in the least in its further search for food.

Known only from Panama Bay. Our specimens are from Taboga Island and Panama.

49. Genus **Echidna** Forster.

Echidna Forster, Icones Ineditæ, 1777, 181 (type *Echidna variegata* Forster=*Muræna echidna* Gmelin).

Gymnomuræna Lacépède, Hist. Nat. Poiss., V, 1803, 648 (type *Gymnomuræna doliata* Lacépède).

Megaderus Rafinesque, Analyse Nat., etc., 1815, 93 (substitute for *Echidna* Forster).

Pœcilophis Kaup, Cat. Apod. Fish Brit. Mus., 1856, 98 (type *Gymnothorax catenatus* Bloch).

Body elongate, somewhat compressed; dorsal and anal fins moderately developed and connected with the caudal; origin of dorsal in front of gill-openings; mouth large, the teeth blunt, without differentiated canines, in 1 or 2 series; teeth on shaft of vomer similar to those on its anterior portion but smaller; nostrils circular, the anterior with a well developed tube, the posterior one with a prominently raised margin forming a slight tube.

KEY TO THE SPECIES.

a. Color dark, with small yellow dots; teeth rather slender, not very blunt. *nocturna*, p. 171.

aa. Color dark, with reticulations of white or yellowish white; teeth coarse, very blunt. *catenata*, p. 171.

113. Echidna nocturna (Cope).

Pœcilophis nocturnus Cope, U. S. Geol. Surv. Mont., 1871 (1872), 474 (Rio Grande at San José, Costa Rica).

Echidna nocturna Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 402 (Cape San Lucas).

Body moderately robust, compressed; the tail a little shorter than head and trunk, 2.05 in total length; head rather short, very fleshy at nape, 3.9 to 4.2 in head and trunk; the greatest depth about 1.5 in head; snout pointed, of same length as mandible, 5.6 to 6 in head; eye 2 in snout, 11.2 to 11.8 in head; mouth large, reaching far beyond eye; the gape 2.9 to 3 in head when measured from tip of lower jaw to angle of mouth; teeth mostly bluntish, those in the lower jaw in 2 series throughout; teeth in upper jaw anteriorly uniserial, then a slight interval without teeth followed by a narrow band of small, rather pointed teeth; vomer anteriorly with a single series of large blunt teeth, posteriorly with 2 series of smaller blunt teeth; gill-opening an oblique slit, scarcely longer than eye; origin of dorsal in advance of gill-opening by a distance equal to length of snout; the fins rather fleshy, the dorsal notably higher than the anal, confluent around the tail.

Color black, brown on belly; sparsely speckled with yellowish spots which are smaller than pupil and are round and regular in one specimen, in another they are somewhat larger and irregular in shape, some being elongate or even half-moon shaped; spots wanting on abdomen. The fins are colored like the body, the dorsal with yellowish spots like the back.

This eel is represented in the present collection by 3 specimens, ranging in length from 620 to 725 mm. These were taken with hook and line at the garbage dump of the U. S. Isthmian Canal Commission Sanitorium at Taboga Island. A rare species.

Known from Cape San Lucas to the Galapagos Islands. Our specimens are from Taboga Island.

114. Echidna catenata (Bloch).

Gymnothorax catenatus Bloch, Ichthyol., XII, 1795, 74, Pl. CCCCXV, fig. 1 (Coromandel; an error).

Echidna fuscomaculata Poey, Repertorio, 1868, 263 (Cuba).
Echidna flavofasciata Poey, Syn. Pisc. Cub., 1868, 264 (Cuba).
Muræna catenata Günther, Cat. Fish. Brit. Mus., VIII, 1870, 130; Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2(Colon).
Echidna catenata Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 403.

Body moderately robust, compressed; the tail shorter than head and trunk, 2.3 to 2.4 in total length; head rather short, fleshy at nape, 3.8 to 4 in head, the greatest depth nearly 2 in head; snout moderately pointed, scarcely in advance of lower jaw, 6 to 6.4 in head; eye 1.5 to 2.2 in snout, 10 to 12 in head; mouth large, reaching far beyond eye; the gape 3 to 3.2 in head when measured from tip of lower jaw to angle of mouth; teeth notably coarser and blunter than in *E. nocturna,* the arrangement very similar, differing only in having some small teeth on the outside of the large series in upper jaw, forming an indefinite second series at anterior part of side; gill-opening an oblique slit scarcely as long as eye, with free and slightly raised margin; origin of dorsal in advance of the gill-opening by a distance a little longer than snout; the dorsal fin much higher than the anal, confluent with it around the tail.

Color brownish black; everywhere with pale yellowish or whitish reticulations, sometimes forming bars or half-bars which branch on the side, enclosing roundish areas of the ground color; the pale usually predominating on chin and abdomen where it encloses black spots. The fins are blackish and reticulated like the body.

There are 3 specimens of this eel in the present collection, respectively 400, 480 and 490 mm. in length. This is a common species on the coral reef at Colon, where it may be seen lying in the water-filled crevices during low tide, but it is extremely difficult to capture. The specimens at hand were speared. While the eels are in the crevices it is generally of no avail to spear them, as they are able to offer such effectual resistance that the spear usually pulls out of the flesh. They, however, occasionally become so irritated by being disturbed that they venture to come out from among the crevices to show fight. It is then that they may be speared and captured. This eel is undoubtedly very destructive to small fish, for it was noticed that it is quick to proceed from the corals upon the approach of the incoming tide in order to catch the little fish that commonly run ahead of the tide in the shallow water. One female taken April 4 is

in spawning condition, containing well developed eggs which are about 1.25 mm. in diameter.

Known from Bermuda south to Brazil; also recorded from West Africa. Our specimens are from Colon.

Order IX. Isospondyli.

Family XXV. Elopidæ.

The Tarpons.

Body elongate, more or less compressed; mouth broad; the lower jaw projecting; maxillary extending beyond eye; premaxillaries protractile; an elongate bony plate between the branches of the lower jaw; villiform teeth on jaws, vomer, palatines, pterygoids, tongue and base of skull; eye large, with an adipose eyelid; opercular bones with membranous border; gill-membranes separate, free from the isthmus; branchiostegals numerous, 29 to 35; lateral line present; scales large or small, wanting on head; dorsal fin inserted over or slightly behind ventrals, depressible in a scaly sheath; no adipose fin; caudal fin forked; axil of pectorals and ventrals each with a long accessory scale.

KEY TO THE GENERA.

a. Pseudobranchiæ wanting; scales large; lateral line decurved; dorsal fin smaller than the anal, the last ray produced into a long filament. *Tarpon*, p. 173.

aa. Pseudobranchiæ large; scales small; lateral line straight; dorsal fin larger than the anal, the last ray short. *Elops*, p. 175.

50. Genus **Tarpon** Jordan & Evermann.

Tarpon Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 409 (type *Megalops atlanticus* Cuvier & Valenciennes).

Body oblong, rather strongly compressed; mouth large, very oblique, the lower jaw strongly projecting; maxillary broad, extending beyond eye; pseudobranchiæ wanting; lateral line decurved; scales rather large, not forming a sheath on dorsal or anal; axil of pectoral and anal with a moderately large accessory scale; dorsal fin anteriorly elevated, the last rays of fin produced, filamentous; anal fin similar but larger, the last ray not notably produced; ventrals inserted well in advance of dorsal.

The tarpons reach a large size, 110 pounds, but they are not highly valued as food. They are much sought after by anglers, as they offer good sport, being excellent fighters. A single species is known from American waters.

115. Tarpon atlanticus (Cuvier & Valenciennes).

Megalops atlanticus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 398 (Guadeloupe; San Domingo; Martinique; Porto Rico).

Megalops elongatus Girard, Proc. Ac. Nat. Sci. Phila., 1858 (1859), 224 (Long Island).

Megalops thrissoides Günther, Cat. Fish. Brit. Mus., VII, 1868, 472 (Not of Bloch & Schneider).

Tarpon atlanticus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 409.

Head 4.1 to 4.3; depth 3.4 to 3.85; D. 12 to 15; A. 20 to 23; scales 42 to 47.

Body elongate, rather strongly compressed; the ventral outline much more strongly curved than the dorsal; dorsal profile slightly concave over head; head moderate, notably compressed; snout short, broad, 4.8 to 5.1 in head; eye 3.9 to 4.65; mouth large, oblique, the jaws strongly curved; the lower jaw much in advance of the upper; maxillary reaching far beyond eye, 1.5 to 1.7 in head; teeth all small, in villiform bands; gill-rakers slender, 32 to 36 on lower limb of first arch; lateral line decurved; scales rather large, cycloid, wanting on head, present on base of anal but wanting on dorsal, the accessory scale in the axil of pectoral and ventrals less than half the length of fin; dorsal fin short, anteriorly notably elevated, the last ray filamentous, nearly equal to depth of body; caudal fin broadly forked, the lobes equal; anal fin similar to the dorsal, but longer, the posterior rays somewhat produced but not filamentous; ventral fins moderate, inserted well in advance of origin of dorsal; pectorals inserted low, under posterior margin of opercle, 1.1 to 1.6 in head.

Color uniform bluish silvery above; sides and lower parts bright silvery; pectoral and ventral fins pale, the other fins more or less dusky.

Five specimens, ranging from 300 to 575 mm. in length, were preserved. Large examples, of one meter or more in length, were occasionally seen. One large individual one day leaped from the water into our row boat while rowing through Mindi Cut. It is used as food to some extent and may be seen in the Colon market from time to time.

Known from Massachusetts to Brazil. Our specimens are from New Gatun, Mindi and Colon.

51. Genus **Elops** Linnæus.

Elops Linnæus, Syst. Nat., Ed. XII, 1766, 518 (type *Elops saurus* Linnæus).

Mugilomorus Lacépède, Hist. Nat. Poiss., V, 1803, 398 (type *Mugilomorus anna-carolina* Lacépède=*Elops saurus* Linnæus).

Trichonotus Rafinesque, Analyse Nat., etc., 1815, 88 (substitute for *Mugilomorus* Lacépède).

Body elongate; opercular bones thin, with membranous borders; pseudobranchiæ present, large; lateral line straight, with simple tubes; scales thin, forming a very high sheath on dorsal and anal; axil of pectoral and ventral each with an excessively long accessory scale; dorsal fin anteriorly elevated, the last rays short; anal fin similar but somewhat smaller. Large fishes, widely distributed. The young flat, ribbon-shaped, passing through a metamorphosis like the eels.

KEY TO THE SPECIES.

a.	Gill-rakers 11 to 14.	*saurus*, p. 175.
aa.	Gill-rakers 18 to 20.	*affinis*, p. 176.

116. **Elops saurus** Linnæus.

Elops saurus Linnæus, Syst. Nat., Ed. XII, 1766, 518 (Carolina); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 410 (Part, not of Linnæus).

Argentia carolina Linnæus, Syst. Nat., Ed. XII, 1766, 519 (Carolina).

Mugilomorus anna-carolina Lacépède, Hist. Nat. Poiss., V, 1803, 398 (South Carolina).

Elops capensis Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 445 (New York).

Head 3.4 to 4; depth 5.2 to 6.5; D. 22 to 25; A. 15 to 17; scales 100 to 115.

Body elongate, moderately compressed; the back not elevated; head long and low; snout broad, tapering, 4.25 to 4.8 in head; eye with a heavy adipose lid in adult, the diameter 4 to 4.5 in head; mouth very large, terminal, the lower jaw projecting in adult; maxillary reaching far beyond eye, 1.67 to 1.75 in head; teeth all small, present on jaws, vomer, palatines and tongue, those on jaws in a rather narrow band; the vomerine teeth in 2 separate triangular patches; gill-rakers rather

slender, 11 to 14 on lower limb of first arch; scales rather small, thin, with scalloped membranous border, wanting on head, extending on caudal fin and forming a broad sheath on base of dorsal and anal; an excessively large scale present on axil of both the pectoral and ventral; dorsal fin inserted somewhat nearer base of caudal than tip of snout, elevated anteriorly, the posterior rays short, completely covered by a sheath of scales; caudal fin deeply forked, the lobes equal; anal fin similar to dorsal but smaller, its origin about midway between base of ventrals and base of caudal; ventral fins inserted under origin of dorsal, equal in length to pectorals; pectoral fins inserted on lower edge of body under posterior margin of opercle, 1.75 to 1.9 in head.

Color uniform bluish above, silvery on sides and below; dorsal and caudal more or less dusky, the other fins pale.

Of this species we preserved 18 specimens, ranging in length from 163 to 550 mm. This fish is apparently not very abundant, and it is not often seen in the market.

Known from the Atlantic coast of America, from Massachusetts to Brazil. Our specimens are from Toro Point, Mindi Cut and Colon.

117. Elops affinis Regan.

Elops saurus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 39 (Panama Bay; not of Linnæus).

Elops affinis Regan, Ann. & Mag. Nat. Hist., Ser. 8, III, 1909, 38 (Mazatlan; Jalisco).

This species appears to agree with *E. saurus* in all respects except in the increased number of gill-rakers, there being constantly 18 to 20 on the lower limb of the first arch, instead of 11 to 14 as in *E. saurus*. We, however, have one specimen, U. S. N. M. No. 79467, which has caused us considerable inconvenience. This specimen is labeled "Panama Market," but it has only 14 gill-rakers on the lower limb of the first arch. This led to the examination of a very large series of specimens from various localities on both coasts of America, in which we found the difference in gill-rakers from the opposite coasts absolutely constant, and we, therefore, have been obliged to conclude that this one specimen is either abnormal or wrongly labeled. Fish are not infrequently shipped from the Pacific coast of Panama to the Atlantic, but we never knew the reverse to be true, yet it may be possible that this is occasionally done.

There are at hand 6 specimens of the larval form of this species, all of about uniform size, being 33 mm. long. The larvæ at this stage are still ribbon-shaped, but the head is much depressed and very

small; the mouth is terminal or nearly so, and large, the gape reaching under middle of eye. There are sharply pointed teeth on the jaws. The caudal fin is well developed and broadly forked, the pectorals and ventrals are entirely wanting, and the dorsal and anal are just becoming differentiated, but still appear partly as mere skin folds. The body is transparent, the only pigment spots present appearing on the caudal fin.

This species, in addition to the larvæ mentioned above, is represented by 7 adult specimens, ranging in length from 300 to 620 mm. This fish is not infrequently seen in the market, but it does not appear to be very common. One of our specimens was taken in a muddy tide stream 6 miles inland.

Known from California to Ecuador. Our specimens are from Chame Point, Balboa, Corozal and the Panama City market.

Family XXVI. **Albulidæ.**

The Bonefish or Ladyfish.

Body elongate, little compressed; snout conic, projecting much in advance of mouth; mouth small, horizontal; both jaws, vomer and palatines with bands of villiform teeth; broad patches of short, coarse, blunt teeth on the tongue and base of skull; eye moderate, nearly entirely covered with an adipose eyelid in adult; pseudobranchiæ present; gill-membranes separate, free from the isthmus; gill-rakers tubercular; branchiostegals about 14; a fold across gill-membranes anteriorly, with free crenate edge posteriorly; no gular plate; lateral line present, straight; scales moderate, wanting on head; dorsal fin larger than anal, inserted in advance of ventrals; no adipose fin; caudal broadly forked.

A single species is known. The young pass through a metamorphosis like the eels. The larvæ are flat, ribbon-shaped and transparent, and are said to become reduced in length from 80 mm. to about 50 mm., while undergoing the change from the larval form to that of the adult fish.

52. Genus **Albula** Gronow.

Albula Gronow, Zoophyl., V, 1763, 102 (type *Esox vulpes* Linnæus); Bloch & Schneider, Syst. Ichth., 1801, 432 (type *Albula conorhynchus* Bloch & Schneider=*Esox vulpes* Linnæus).

Butyrinus Lacépède, Hist. Nat. Poiss., V, 1803, 45 (type *Butyrinus banana* Lacépède=*Esox vulpes* Linnæus).

Glossodus Cuvier, in Agassiz, Spix, Pisc. Brasil., 1829, 48 (type *Glossodus forskåli* Agassiz).

The characters of the genus are included in the family description.

118. Albula vulpes (Linnæus).

Esox vulpes Linnæus, Syst. Nat., Ed. X, 1758, 313 (Bahamas, based on *Vulpes bahamensis* of Catesby).

Clupea brasiliensis Bloch & Schneider, Syst. Ichth., 1801, 427 (Brazil).

Albula conorhynchus Bloch & Schneider, Syst. Ichth., 1801, 432 (Antilles).

Amia immaculata Bloch & Schneider, Syst. Ichth., 1801, 451 (Central America).

Clupea macrocephala Lacépède, Hist. Nat. Poiss., V, 1803, 426 (Martinique).

Glossodus forskåli Agassiz, in Spix, Pisc. Brasil., 1829, 49 (Bahia). Called *Engraulis sericus* and *Engraulis bahiensis* on plates XXII and XXIV.

Albula parræ Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 339 (Martinique; Bahia; Rio de Janeiro).

Albula rostrata Gronow, Cat. Fish, 1854, 189 (American Ocean, etc.).

Albula vulpes Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 411; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 39 (Panama).

Head 3.4 to 3.7; depth 4.15 to 4.9; D. 16 or 17; A. 8; scales 65 to 75.

Body elongate, moderately compressed; the dorsal profile more strongly convex than the ventral; head low, more or less quadrangular; snout long, pointed, projecting far beyond mouth, 2.4 to 2.5 in head; eye with a very large, heavy, adipose eyelid in adult, its size moderate, 4 to 5.15 in head; mouth inferior, horizontal; maxillary failing to reach eye, 2.7 to 3 in head; teeth on jaws, vomer and palatines in villiform bands; the pterygoids, base of skull and tongue with short, blunt teeth; gill-rakers undeveloped, appearing as rough tubercles; scales moderate, with membranous border, wanting on head, densely covering all the fins; dorsal fin anteriorly elevated, the posterior margin moderately concave; caudal fin deeply forked, the lobes equal; anal fin very small, similar in shape to dorsal; ventral fins moderate, inserted under last rays of dorsal; pectoral fins moderate, inserted under posterior margin of opercle, 1.7 to 2 in head.

Color bluish above; sides and below bright silvery; faint dark lines between the rows of scales; the margins of dorsal and caudal dusky, all the fins otherwise pale.

The larval form was taken on both coasts. Specimens at hand range in length from 40 to 60 mm., the smallest ones being most nearly like the adult form, but they are posteriorly, at least, still much compressed. The head has assumed many of the adult characters, the snout projects notably beyond the mouth, the mouth is larger than in adult, the maxillary reaching a little beyond anterior margin of eye. All the fins have become differentiated in the specimens at hand, but a prominent dermal fold remains in front of anal and behind pectorals. The caudal fin is well developed and is broadly forked. The body at this stage is still void of pigment. The larvæ of this species may be distinguished from those of *Elops* by the larger and deeper head, projecting snout, and smaller mouth.

This species is represented by 18 adult specimens, ranging in length from 160 to 390 mm., and 19 larvæ. This fish is apparently not abundant on either coast of Panama, as it was not often seen. It is used as food to a limited extent.

A widely distributed species, known from all tropical seas. Our Pacific coast specimens are from Balboa, and the Atlantic specimens are from Colon.

Family XXVII. Clupeidæ.

The Herrings.

Body oblong or elongate, more or less compressed; belly rounded or compressed, when compressed often armed with bony serratures; head naked, usually compressed; mouth rather large, terminal; the maxillaries each of three pieces, forming the lateral margin of upper jaw; premaxillaries not protractile; teeth usually small, often feeble or wanting, variously arranged; adipose eyelid present or absent; gill-rakers long and slender; gill-membranes not connected, free from the isthmus; gills 4, a slit behind the fourth; no gular plate; branchiostegals usually few, 6 to 15; pseudobranchiæ present; no lateral line; scales cycloid or pectinate; dorsal fin median or somewhat posterior, rarely wanting; no adipose fin; ventrals, if present, moderate or small; anal usually rather long; caudal forked. Vertebræ 40 to 56.

KEY TO THE GENERA.

a. Anal fin short, with fewer than 30 rays; dorsal inserted over or in advance of base of ventrals.

b. The last ray of dorsal normal, not produced into a long filament.

c. Belly more or less rounded; ventral scutes weak; gill-rakers very numerous, about 65 on lower limb of first arch. *Clupanodon*, p. 180.

cc. Belly strongly compressed; ventral scutes strong; gill-rakers less numerous, fewer than 50 on the lower limb of first arch. *Sardinella*, p. 181.

bb. The last ray of dorsal produced into a long filament. *Opisthonema*, p. 186.

aa. Anal fin long, with more than 30 rays; dorsal inserted back of base of ventrals when latter are present.

d. Ventral fins present. *Ilisha*, p. 189.

dd. Ventral fins wanting.

e. Maxillary normal, not produced, and not extending beyond eye. *Opisthopterus*, p. 191.

ee. Maxillary greatly produced in adult, extending beyond eye. *Odontognathus*, p. 193.

53. Genus **Clupanodon** Lacépède.

Clupanodon Lacépède, Hist. Nat. Poiss., V, 1803, 468 (type *Clupea thrissa* Linnæus).

Thrissa Refinesque, Analyse Nat., etc., 1815, 88 (substitute for *Clupanodon*, regarded as an objectionable name).

Sardinia Poey, Memorias, II, 1861, 311 (type *Sardinia pseudo-hispanica* Poey).

Body elongate; ventral serratures weak; adipose eyelid present; teeth in the jaws weak; vomer toothless; scales thin, deciduous; gill-rakers long and slender, very numerous.

119. **Clupanodon pseudohispanicus** (Poey).

Sardinia pseudo-hispanica Poey, Memorias, II, 1861, 311 (Cuba).

Clupea pseudohispanica Kendall & Smith, Bull. U. S. Fish Comm., XIV, 1894 (1895), 17.

Clupanodon pseudohispanicus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 423.

Head 3.5 to 4.3; depth 3.85 to 4.45; D. 16 or 17; A. 16 to 18; scales 45 to 50.

Body elongate, compressed, the belly not sharply compressed, its scutes small, 18 or 19 + 13 to 16; head usually about equal to depth; snout rather long, equal to or slightly longer than eye, its length

3.4 to 3.8 in head; eye 3.7 to 4.3; mouth small, not very oblique; the lower jaw scarcely in advance of the upper; maxillary short, scarcely reaching anterior margin of pupil, 2.5 to 2.85 in head; teeth small, present on both jaws and tongue; gill-rakers numerous, long and slender, about 65 on the lower limb of first arch; scales of moderate size, thin, usually many of them falling away in preserved specimens; dorsal variable in its position, but always notably nearer tip of snout than base of caudal; anal short and low, its base shorter than head; ventrals usually inserted under about the middle of base of dorsal, occasionally under posterior fourth of base of dorsal; pectorals short, 1.5 to 1.7 in head.

Color bluish above; sides golden and silvery; peritoneum dusky; fins unmarked.

This species was not taken by us, and it is not recorded from south of the West Indies. Recently, however, 4 specimens from Margarita Island, Pompater, Venezuela, were submitted to us by the Bureau of Fisheries for identification. Although these four examples were in poor condition, they were pretty certainly identified as this species. It is, therefore, likely to occur on the Atlantic coast of Panama. The above description is based on numerous specimens from Woods Hole, Massachusetts, Cuba and Jamaica.

With this new record the range extends from Cape Cod to the Coast of Venezuela.

54. Genus **Sardinella** Cuvier & Valenciennes.

Sardinella Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 1847, 261 (type *Sardinella aurita* Valenciennes).

Body compressed; snout emarginate, the lower jaw projecting; ventral scutes 25 to 35 in number; teeth weak; scales large and usually adherent, often with striæ; gill-rakers long and rather numerous; the dorsal inserted in advance of ventrals; the vertebræ in reduced number, about 40 to 44.

KEY TO THE SPECIES.

a. Sides with a very distinct silvery lateral band; median line of back with a dark streak; palatines and pterygoids toothless. *stolifera*, p. 182.

aa. Sides without a silvery lateral band; no dark streak on median line of back; palatine and pterygoids with teeth. (Last character not verified for *anchovia*.)

b. Body very elongate, the depth 4.5 in length; head 4.5; a black opercular spot present. *anchovia*, p. 183.

bb. Body deep, the depth 3.0 to 3.8 in length; head 3.0 to 3.9; no black opercular spot present.

c. Scales little adherent, their edges mostly smooth, those on sides with vertical striæ; gill-rakers rather few, about $\frac{2}{5}$ on lower limb of first arch; dorsal not much in advance of ventrals, inserted at a point notably nearer vent than tip of snout; no humeral spot. *sardina*, p. 183.

cc. Scales firm, their edges mostly crenate, at least of those on back, without evident vertical striæ; gill-rakers numerous, about 32 on the lower limb of first arch; dorsal much in advance of ventrals, inserted at a point about midway between tip of snout and vent; a humeral spot usually present.

d. Scales on back with strongly developed horizontal striæ, and crenate edges, those on sides nearly smooth. *macrophthalmus*, p. 184.

dd. Scales on back without evident striæ, the edges of scales both on back and sides crenate. *thrissina*, p. 185.

120. Sardinella stolifera (Jordan & Gilbert).

Clupea stolifera Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 339 (Mazatlan); Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 335, 1899, 1 (Guayaquil).

Sardinella stolifera Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 431; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 39 (Panama Bay).

Head 3.95 to 4.6; depth 3.2 to 3.5; D. 15 to 18; A. 15 to 18; scales 38 to 41.

Body rather deep, much compressed; the belly strongly arched, armed with 16 or 17 + 12 to 14 scutes; head short and deep, almost as deep as long; eye rather large, with an adipose eyelid, 2.65 to 3 in head; snout short, emarginate, 3.8 to 4.2 in head; mouth moderate, the lower jaw projecting; the maxillary rather wide, rounded posteriorly, reaching slightly past the anterior margin of eye, 2.2 to 2.4 in head; a few very small teeth present on both jaws, and a longitudinal patch on median line of tongue; vomer, palatines, and pterygoids toothless; gill-rakers long and slender, about 32 on the lower limb of the first arch; pseudobranchiæ strongly developed; scales rather thin, more or less deciduous, without evident striæ, their edges somewhat ragged; dorsal and anal with a scaly sheath; the dorsal inserted very slightly

in advance of the base of ventrals, notably nearer vent than tip of snout; anal rather low; pectorals reaching about three-fourths the distance to base of ventrals, 1.15 to 1.25 in head.

Color greenish above; sides pale silvery. A very strongly defined silver lateral band present, the width of which is equal to the length of snout; median line of back with a dark streak; scales above lateral band with dusky punctulations; tip of snout and lower jaw dusky; tips of caudal lobes black.

This species is represented by 33 specimens, ranging from 85 to 130 mm. in length, taken in tide streams and along a sandy beach. We have for comparison numerous type specimens from Mazatlan.

Known from the Gulf of California to Guayaquil. Our specimens are from Corozal and Balboa.

121. Sardinella anchovia Cuvier & Valenciennes.

Sardinella anchovia Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 1847, 269 (Rio Janeiro; Martinique); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 429.

Clupea anchovia Günther, Cat. Fish. Brit. Mus., VII, 1868, 421.

Head about 4.5; depth 4.5; D. 16; A. 16.

Body elongate and slender; suborbital bones finely venulose; teeth on tongue and palatines, none on vomer; jaws mostly toothless; scales smooth, large, striated; dorsal nearer snout than base of caudal; the ventrals inserted below its middle.

A black spot on opercle above.

A little known species. Not seen by us. Recorded from Martinique and Rio Janeiro, Brazil.

122. Sardinella sardina (Poey).

Harengula sardina Poey, Memorias, II, 1861, 310 (Cuba).

Harengula callolepis Goode, Proc. U. S. Nat. Mus., 1879, 152 (Bermuda).

Harengula clupeola Jordan, Proc. U. S. Nat. Mus., 1889, 646 (not of Cuvier & Valenciennes).

Sardinella sardina Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 430, Pl. LXXIII, fig. 193.

Head 3.0 to 3.55; depth 3.0 to 3.4; D. 17 or 18; A. 17 to 19; scales 37 to 40.

Body rather deep, compressed; the ventral outline not as strongly arched as in related species; belly moderately compressed, forming a keel which is armed with 16 or 17 + 11 or 12 scutes; head somewhat

elongate, notably longer than deep; eye large, with an adipose eyelid moderately developed, 2.6 to 3.05 in head; snout shorter than eye, 3.4 to 4 in head; mouth rather large, the lower jaw projecting; the maxillary moderately wide, rounded posteriorly, usually not quite reaching middle of eye, 2.0 to 2.2 in head; teeth present on jaws, tongue, palatines, and pterygoids; gill-rakers long and slender, about 25 present on lower limb of first arch; pseudobranchiæ well developed; scales rather thin, more of less deciduous, those on back without strongly developed longitudinal striæ, those on sides with vertical striæ, their edges almost smooth; dorsal and anal with a scaly sheath; the dorsal inserted in advance of the ventrals, notably nearer vent than tip of snout; the anal very low; pectorals not reaching base of ventrals, 1.4 to 1.5 in head.

Color bluish above, sides silvery; snout and lower jaw with dusky points; tips of dorsal and caudal lobes dusky; no humeral spot, and no lateral band.

This species was not taken by us at Panama. The above description is based on several specimens from Cuba and Cozumel.

Known from Florida and the West Indies. Recently doubtfully recorded from Natal, Brazil, by Prof. Starks (Leland Stanford Jr. Univ. Pub., Univ. Ser., 1913, p. 8.).

123. Sardinella macrophthalmus (Ranzani).

Clupea macrophthalma Ranzani, Nov. Comment. Ac. Sci. Inst. Bonon., V, 1842, 320 (Brazil).

Harengula maculosa Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 1847, 292 (Martinique).

Harengula humeralis Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 1847, 293 (Rio Janeiro; Bahia; Guadeloupe; San Domingo).

Alausa striata Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 1847, 429 (Guadeloupe; Bahia).

Harengula jaguana Poey, Repertorio, I, 1866, 190 (Jagua, Cuba).

Clupea humeralis Günther, Cat. Fish. Brit. Mus., VII, 1868, 422 (Pensacola, Florida).

Harengula pensacolæ Goode & Bean, Proc. U. S. Nat. Mus., 1879, 152.

Harengula macrophthalma Jordan, Proc. U. S. Nat. Mus., 1889, 646.

Harengula arcuata Jordan, Proc. U. S. Nat. Mus., 1889, 646.

Sardinella macrophthalmus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 430.

Sardinella humeralis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 431.

Head 3.3 to 3.9; depth 2.7 to 3.8; D. 16 or 17; A. 16 to 18; scales 38 to 40.

Body rather deep, variable; the ventral outline strongly curved; belly compressed into a keel which is armed with 15 to 18 + 12 or 13 scutes; head deep, compressed; snout short, 3.35 to 4.5 in head; mouth moderate; the lower jaw projecting; the maxillary broadly rounded posteriorly, reaching anterior margin of pupil to middle of eye; eye large, with a well developed adipose eyelid, 2.6 to 3 in head; teeth present on both jaws, tongue, palatines, and pterygoids; gill-rakers rather long and slender, about 32 present on lower limb of first arch; pseudobranchiæ strongly developed; scales firm, adherent, those on the back with crenate edges and very evident longitudinal striæ, those on sides without evident striations (Plate IX, fig. a.); dorsal and anal with a scaly sheath; the dorsal inserted in advance of ventrals, about midway between tip of snout and vent; the anal very low; pectorals not nearly reaching base of ventrals, 1.2 to 1.45 in head.

Color bluish black above; sides silvery; a humeral spot usually present; sides with a dark streak, bounding the dark of the back; a paler streak above this one; these streaks usually most evident in young, frequently wholly wanting in adult; snout with dusky points.

Of this species we have over 300 specimens, ranging from 40 to 135 mm. in length. Besides these we have examined specimens (variously labelled *macrophthalmus, humeralis,* or *pensacolæ*) from Florida, Texas, Bermuda, Porto Rico, San Domingo, and Puerto Morelos. While there is considerable variation among individuals, especially with respect to depth of body, we find no constant differences. Therefore several nominal species are here included. That the examples from the more northern localities are deeper than the others, as has been said, cannot be verified. Some specimens from Porto Bello are quite as deep as some Florida specimens.

Known from Florida southward to Brazil. Our specimens are from Toro Point, Colon, and Porto Bello.

124. Sardinella thrissina (Jordan & Gilbert).

Clupea thrissina Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 353 (Cape San Lucas).

Sardinella thrissina Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 430; Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 80 (Toboguilla Island, Panama Bay).

Head 3.5 to 3.8; depth 2.8 to 3.5; D. 16 or 17; A. 15 to 17; scales 37 to 42.

Body deep, compressed; the ventral outline strongly curved; the belly compressed into a keel which is armed with 17 + 12 to 14 scutes; head deep, compressed, snout shorter than eye, 3.8 to 5 in head; mouth moderate; lower jaw projecting; maxillary broadly rounded posteriorly, reaching to or slightly past middle of eye; eye rather large, 2.7 to 3.3 in head, adults with a well developed adipose eyelid; teeth present on both jaws, tongue, palatines, and pterygoids; gill-rakers long and slender, about 31 on lower limb of first arch; pseudobranchiæ greatly developed; scales firm, adherent, without striæ extending over the scales, the edges crenate (Plate IX, fig. b.); dorsal and anal with scaly sheath; the dorsal inserted in advance of the ventrals, about midway between tip of snout and vent; the anal very low; pectorals reaching two-thirds the distance to base of ventrals, 1.25 to 1.45 in head.

Color bluish black above; sides silvery; an inconspicuous humeral spot usually present; sides with a dark streak, bounding the dark on the back; a paler streak above this one; these streaks frequently not very evident; snout with dusky points.

This species is represented in the present collection by 13 specimens, ranging from 75 to 90 mm. in length. We have had for comparison the types, and some small specimens collected by the Albatross at Acapulco and Taboguilla Island, Panama Bay. *S. thrissina* is very closely related to the Atlantic form, *S. macrophthalmus,* from which we are able to distinguish it only by a difference in the scales. In *S. thrissina* all of the scales have crenate edges, but there are no evident striations on the body of the scales. In *S. macrophthalmus* only the scales on the back have notably crenate edges, and the body of the scales bears evident striations.

Known from the Gulf of California southward to Panama Bay. Our specimens are from Taboga Island.

55. Genus **Opisthonema** Gill.

Opisthonema Gill, Proc. Ac. Nat. Sci. Phila., 1861, 37 (type *Clupanodon thrissa* Lacépède, not of Osbeck=*Megalops oglina* Le Sueur).

Differing from *Sardinella* only in having the last ray of the dorsal produced in a long filament.

KEY TO THE SPECIES.

a. Dorsal with 17 to 20 rays; anal with 22 to 25; pectorals rather long, 1.2 to 1.3 in length of head; rows of scales with more or less distinct streaks. *oglinum,* p. 187.

aa. Dorsal with 15 to 17 rays; anal with 19 to 22; pectorals shorter, 1.4 to 1.6 in length of head; rows of scales with faint streaks or none. *libertate*, p. 188.

125. Opisthonema oglinum (Le Sueur).

Clupea thrissa Broussonet, Ichthyologia, fasc. I, 1782, (Carolina; Jamaica. Not of Osbeck, 1757, which is a Chinese species of *Dorosoma*).

Megalops oglina Le Sueur, Journ. Ac. Nat. Sci. Phila., I, 1817, 359 (Newport, Rhode Island).

Megalops notata Le Sueur, Jour. Ac. Nat. Sci. Phila., I, 1817, 361 (Guadeloupe).

Chatœssus signifer De Kay, Fauna N. Y., Fishes, 1842, 264, Pl. XLI, fig. 132 (New York).

Chatoëssus eumorphus Gosse, Naturalist's Sojourn in Jamaica, 1851, 290 (Jamaica).

Opisthonemus thrissa Poey, Anal. Soc. Españ. Hist. Nat., X, 1881, 343.

Opisthonema oglinum Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 432.

Head 3.5 to 4.3; depth 2.7 to 3.75; D. 17 to 20; A. 22 to 25; scales 47 to 49.

Body deep, compressed; the ventral outline much more convex than the dorsal; belly compressed into a keel, armed with 17 to 19 + 12 to 15 scutes; head short and deep; the snout not much shorter than the eye, its length 3.6 to 4.1 in head; eye 3.1 to 3.8; adipose eyelids well developed; mouth moderate, terminal, the lower jaw slightly projecting; the maxillary wide and round posteriorly, reaching anterior margin of pupil; teeth absent on jaws, a row of minute ones present on median line of tongue; gill-rakers numerous, long and slender; pseudobranchiæ strongly developed; scales rather large and firm, their sides more or less crenate; dorsal fin inserted in advance of ventrals, much nearer the snout than base of caudal, the last ray much produced, about half the length of body without head; anal rather long, composed of very short rays; pectorals not reaching base of the small ventrals, 1.2 to 1.3 in head.

Color bluish above, in life bluish green; sides silvery; rows of scales with more or less distinct streaks, these most prominent above; young often with a row of blue spots back of the humeral spot, between the blue of back and the silvery on sides; margin of dorsal, dorsal filament, and lobes of caudal dusky; other fins unmarked.

Of this species 61 specimens, ranging in length from 45 to 215 mm., were preserved.

Known from the middle Atlantic States southward to Brazil; occasionally straying northward to Massachusetts. Our specimens are from Mindi Cut; Colon Market; Fox Bay, Colon; and Porto Bello.

126. Opisthonema libertate (Günther).

Meletta libertatis Günther, Proc. Zoöl. Soc. London, 1866, 603 (Libertad, Central America).

Clupea libertatis Günther, Cat. Fish. Brit. Mus., VII, 1868, 433.

Opisthonema libertate Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 622; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 40 (Panama Bay).

Head 3.4 to 4.1; depth 2.9 to 3.4; D. 15 to 17; A. 19 to 22; scales 46 to 52.

Body deep, compressed; the ventral outline much more rounded than the dorsal; belly compressed, forming a keel, armed with 16 to 19 + 14 to 16 scutes; head short and deep; the snout slightly shorter than the eye, its length 3.85 to 4.25 in head; eye 3.45 to 3.7; adipose eyelids well developed; mouth moderate, terminal; the lower jaw slightly projecting; maxillary broad, rounded posteriorly, reaching to about middle of eye; no teeth on the jaws, a row of minute ones on median line of tongue; gill-rakers very numerous, long and slender; pseudobranchiæ strongly developed; scales rather large and firm, their edges slightly crenate; the dorsal inserted in advance of the ventrals, much nearer the snout than base of caudal, the last ray much produced, reaching nearly or quite to base of caudal, more than half the length of body without head; anal moderate, composed of very short rays; pectorals not nearly reaching base of ventrals, 1.4 to 1.6 in head.

Color bluish above, sides silvery; rows of scales with very faint lines or none; a humeral spot usually present, wholly wanting in our largest specimen; a row of small blue spots present back of humeral spot between the blue of back and silvery of sides in young individuals and occasionally in older ones; dorsal and caudal with more or less dusky; other fins unmarked.

This species, although said to be abundant at Panama (Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, p. 40), appeared to be rather rare during our visits. It is represented by 12 specimens, ranging from 60 to 275 mm. in length. It is very closely related to *O. oglinum*, the Atlantic form, but it has fewer rays in the dorsal and anal, slightly shorter pectoral fins, and there is a slight difference in color.

Known from the Pacific coasts of Mexico and Central America. Our specimens are from Chame Point, Taboga Island, and Panama Market.

56. Genus **Ilisha** Gray.

Platygaster Swainson, Nat. Hist. & Class. Fish., II, 1839, 294 (type *Clupea africana* Bloch, name preoccupied).

Ilisha (Gray) Richardson, Ichthyol. China, in Rept. Brit. Assoc., 1845 (1846), 306 (type *Ilisha abnormis* Gray=*Alosa elongata* Bennett).

Pellona Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 1847, 300, (type *Pellona orbignyana* Valenciennes=*Pristigaster flavipinnis* Valenciennes).

Body much compressed, the thorax and abdomen armed with strong scutes; lower jaw prominent; mouth moderate; small teeth present on both jaws, tongue, palatines and pterygoids, none on vomer; scales moderate, more or less deciduous; anal fin very long; ventral fins present, small, inserted in advance of the small dorsal; caudal deeply forked.

KEY TO THE SPECIES.

a. Body deep, the depth 2.5 to 3.4 in length; ventral outline strongly arched; the insertion of the dorsal in advance of anal.

b. Anal with 46 to 50 rays; ventral scutes 23 to 25 + 12 to 14; scales 56 to 61. *fürthii*, p. 189.

bb. Anal with 38 to 41 rays; ventral scutes 18 to 21 + 5 to 7; scales 36 to 39. *argentata* sp. nov., p. 190.

aa. Body very elongate, the depth about 4.4 in length; ventral outline only slightly convex; the insertion of dorsal behind origin of anal. *caribbæa* sp. nov., p. 191.

127. Ilisha fürthii (Steindachner).

Pellona fürthii Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXIX) Ichth. Beitr., I, 1874, 14 (Panama).

Pellona panamensis Steindachner, (Sitzb. k. Ak. Wiss. Wein, LXIX) Ichth. Beitr., I, 1874, 15 (Panama).

Ilisha furthi Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 436; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 40 (Panama Bay).

Head 3.85 to 4.2; depth 2.7 to 3.4; D. 15 to 17; A. 46 to 50; scales 56 to 61.

Body elongate, much compressed; upper profile of head concave; ventral outline strongly convex; ventral scutes 23 to 25 + 12 to 14;

snout shorter than eye, its length 3.6 to 3.85 in head; eye 3 to 3.4; mouth oblique, the lower jaw strongly projecting; maxillary broad, rounded posteriorly, its lower margin serrate, not quite reaching middle of eye, 1.8 to 1.95 in head; a row of minute teeth present in each jaw, a band on median line of tongue, palatines and pterygoids; vomer toothless; gill-rakers rather short and strong, 20 to 24 present on lower limb of first arch; scales large and thin, more or less deciduous; dorsal and anal with scales at base; the dorsal in advance of anal, its last ray over origin of anal, inserted slightly nearer tip of snout than base of caudal; anal long and low, its base equal to about half the length of body without head; pectorals reaching past base of ventrals, 1.2 to 1.4 in head.

Color bluish gray above; sides silvery; snout dusky, upper portion of head with dusky points; all the fins except the ventrals with more or less dusky, at least along their margins.

This species is represented by 15 specimens, ranging from 280 to 385 mm. in total length. A common food fish, but of inferior quality.

Known from Panama southward to Peru. Our specimens are from brackish water at Corozal and from the Panama market.

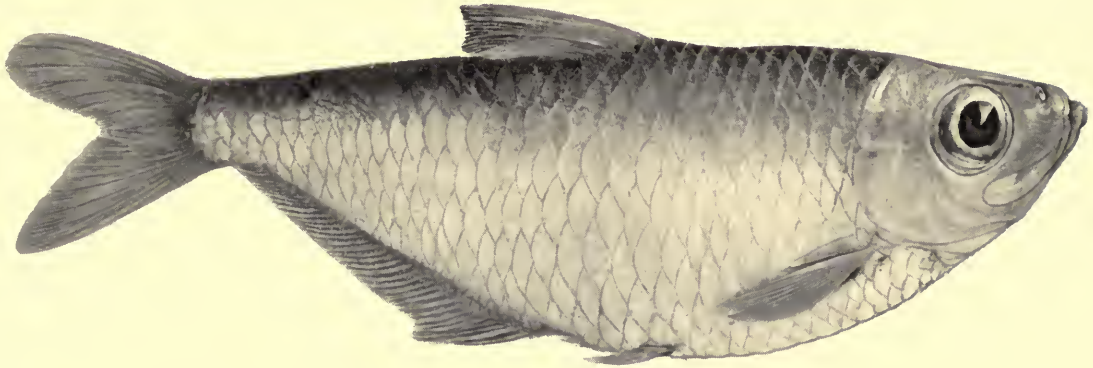
128. Ilisha argentata sp. nov. (Plate IX.)

Type No. 81749, U. S. N. M.; length 155 mm.; Fox Bay, Colon, Panama.

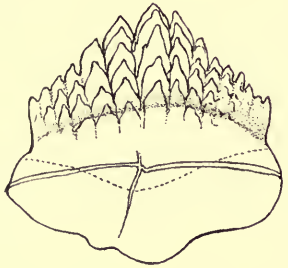
Head 3.4 to 4.0; depth 2.55 to 2.75; D. 14 or 15; A. 38 to 41; scales 36 to 39.

Body rather short and deep, much compressed; the dorsal profile from snout to origin of dorsal straight; ventral outline very strongly arched, scutes 18 to 21 + 5 to 7; snout shorter than eye, slightly emarginate, its length 3.6 to 4.5 in head; eye 2.25 to 2.9; mouth oblique, the lower jaw projecting; maxillary wide posteriorly, its lower margin serrate, reaching middle of eye, 1.75 to 1.9 in head; teeth present on both jaws, tongue, palatines and pterygoids, none on vomer; gill-rakers moderate, 21 to 23 on lower limb of first arch; scales thin, deciduous, many of them lost from specimens at hand; dorsal inserted in advance of anal, about midway between tip of lower jaw and base of caudal, its last ray over about the fourth ray of anal; anal long and rather low, equal to its distance from posterior margin of opercle, more than half the length of body without head; caudal forked, the lobes about equal in length, not produced in a filament; ventrals shorter than eye; pectorals not reaching base of ventrals, 1.3 to 1.4 in head.

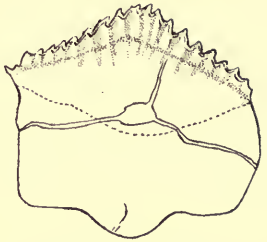
Color bluish gray above; sides silvery; snout and back with dark



ILISHA ARGENTATA sp. nov.
From the type 155 mm. in length.



a. Scale from SARDINELLA MACROPHTHALMUS (Ranzani).
Enlarged 10 x.



b. Scale from SARDINELLA THRISSINA (Jordan & Gilbert).
Enlarged 10 x.

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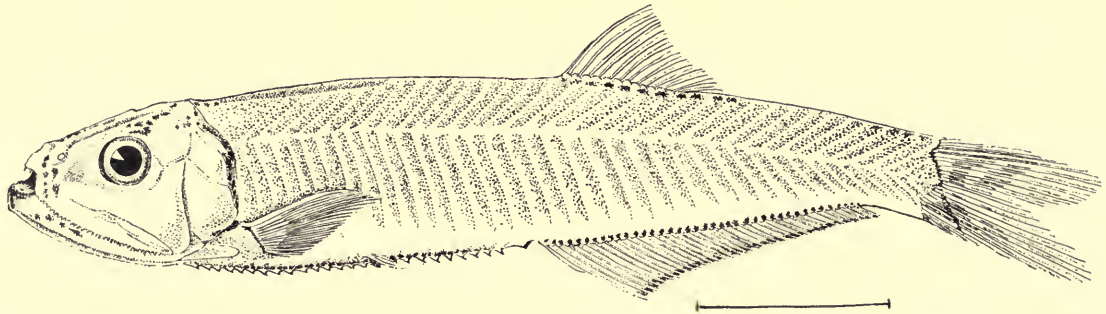

FIG. 1. ILISHA CARIBBÆA sp. nov.
Drawn from the type 57 mm. in length. Scales lost.

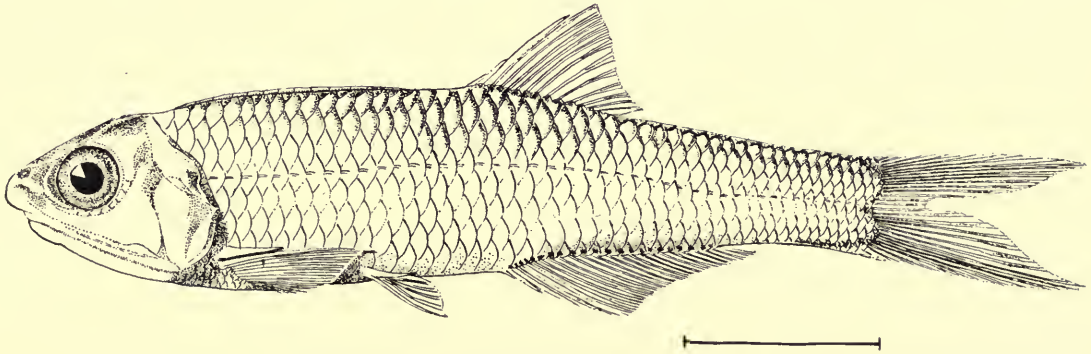

FIG. 2. ANCHOVIA PARVA sp. nov.
Drawn from the type 55 mm. in length.

points, greenish in life; tip of anterior dorsal rays and usually the margin of caudal dusky; dorsal and caudal yellowish in life.

Of this species 30 specimens, ranging in length from 43 to 155 mm., were collected. Taken at Toro Point; Mindi Reef; Colon Reef; Fox Bay, Colon; and Colon market.

129. Ilisha caribbæa sp. nov. (Plate X, fig. 1.)

Type No. 81769, U. S. N. M.; length 57 mm.; Porto Bello, Panama.

Head 4.35 to 4.4; depth 5.35 to 5.5; D. 14; A. 37 or 38.

Body very elongate, strongly compressed; the dorsal profile slightly convex; ventral outline from articulation of lower jaw to origin of anal straight; head much compressed, the interorbital space narrower than the small eye; snout longer than eye, its length 2.65 to 3.15 in head; eye 3.5 to 3.7; mouth little oblique, the lower jaw scarcely projecting; maxillary long, narrow posteriorly, its lower margin very strongly serrate, reaching past posterior margin of eye, 1.15 to 1.22 in head; teeth present on both jaws, tongue, palatines and pterygoids; gill-rakers as long as eye, about 16 on lower limb of first arch; scales all lost; dorsal inserted behind origin of anal, about midway between posterior margin of opercle and base of caudal; anal long and low, its base equal to half the length of body without head; ventrals very small, shorter than eye; pectorals scarcely reaching base of ventrals, 1.3 in head.

Color pale translucent; lower jaw, snout and nape with dark points; a row of dark points just back of margin of opercle, also a row at base of dorsal, caudal, anal and pectorals; rays of caudal with dusky.

Of this species we have but 2 small specimens, 52 and 57 mm. long. This fish is distinguished from related species by its very elongate body and the backward position of the dorsal.

The specimens were taken at Porto Bello.

57. Genus **Opisthopterus** Gill.

Opisthopterus Gill, Proc. Ac. Nat. Sci. Phila., 1861, 37, (type *Pristigaster tartoor* Cuvier & Valenciennes).

Body elongate, very much compressed, the abdomen strongly armed with scutes; the lower jaw projecting; *maxillary not produced;* teeth rather small, in villiform bands on both jaws, tongue, palatines, and pterygoids; vomer toothless; scales thin, deciduous, of moderate size; dorsal fin small, inserted considerably behind middle of body, and behind front of anal; anal fin very long; *ventrals wanting;* caudal deeply forked.

KEY TO THE SPECIES.

a. Body moderately deep, the depth 3.3 to 3.9 in length; eye moderate, 3.0 to 3.2 in head; dorsal inserted much behind origin of anal, much nearer base of caudal than posterior margin of opercle; no black humeral spot. *dovii,* p. 192.

aa. Body deeper, the depth 2.8 to 3.0 in length; eye very large, 2.6 to 2.75 in head; dorsal inserted farther forward, about midway between posterior margin of opercle and base of caudal; a large black humeral spot present. *macrops,* p. 193.

130. Opisthopterus dovii (Günther).

Pristigaster argenteus Günther, Proc. Zoöl. Soc. London, 1866, 603 (not of Cuvier).

Pristigaster dovii Günther, Cat. Fish. Brit. Mus., VII, 1868, 461 (Panama).

Opisthopterus dovii Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 437; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 41 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 81 (Panama Bay).

Head 4.75 to 5.15; depth 3.3 to 3.9; D. 12 or 13; A. 53 to 59; scales 53 to 57.

Body elongate, strongly compressed, the belly armed with 27 to 29 scutes; dorsal profile notably convex anteriorly; head rather short; snout shorter than the large eye, its length 4.4 to 4.35 in head; eye 3 to 3.2; mouth large, very oblique; lower jaw projecting; the maxillary long, reaching slightly past middle of eye, its lower margin distinctly serrate, 1.85 to 1.95 in head; teeth rather strong, present on jaws, tongue, palatines and pterygoids; gill-rakers moderate, 17 or 18 on lower limb of first arch; pseudobranchiæ well developed; scales thin, deciduous; dorsal and anal with a scaly sheath at base; the dorsal small, inserted much behind origin of anal, over about the 18th anal ray, much nearer the base of caudal than posterior margin of opercle; the anal fin very long, but low; pectorals longer than head, 4.3 to 4.5 in body.

Color greenish above; sides silvery; back with a dark band; tip of snout and lower jaw dusky; no dark humeral spot; fins with more or less dusky.

Of this species only 4 specimens, 90 to 180 mm. long, were taken. Besides these we have had for examination a specimen 220 mm. long, taken in Panama Bay by the Albatross. We have compared these specimens with two of the type specimens of *O. lutipinnis* from Mazatlan.

The latter is said to have fewer anal rays, but we find this an unreliable character, as one of our specimens of *O. dovii* has only 53 anal rays, while we are able to count 56 in one of the type specimens of *O. lutipinnis*. We note, however, that the head in the last mentioned species is notably longer, the pectoral fins being about equal to length of head, and the dorsal fin being inserted only slightly back of origin of anal, over about the sixth anal ray, and about midway between posterior margin of opercle and base of caudal.

Known from Panama Bay. Our specimens are from Chame Point, tide pools at Balboa, and the Panama market.

131. Opisthopterus macrops (Günther).

Pristigaster macrops Günther, Proc. Zoöl. Soc. London, 1866, 603 (Panama).

Opisthopterus macrops Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 437; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 41 (Panama Bay).

Of this rare species, Gilbert & Starks (Memoir. Cal. Ac. Sci., IV, 1904, 41) give the following account:

"The species is readily distinguished from *O. dovii* by its much larger eye, more oblique mouth, strongly concave occipital profile, and deeper body with much stronger ventral curvature. The teeth are much smaller than in *O. dovii,* and there is a conspicuous humeral spot, lacking in the latter. In the specimens taken, the head is 4⅗ or 4⅔ in length, the depth 2⅝ to 3. Eye 2⅔ to 2¾ in head. Front of dorsal slightly nearer root of caudal than scapula, farther forward than in *O. dovii.* Pectorals 4½ to 4⅔ in length. Scutes 27. D. 13 or 14. A. 62. Coloration as in *O. dovii,* but with a large black humeral spot."

The species was not seen by us. It is known only from the type specimen, 200 mm. long, and the three specimens, each about 225 mm. long, on which the above account is based; all from Panama Bay.

58. Genus **Odontognathus** Lacépède.

Odontognathus Lacépède, Hist. Nat. Poiss., II, 1800, 221 (type *Odontognathus muricatus* Lacépède).

Gnathobolus Bloch & Schneider, Syst. Ichth., 1801, 556. (type *Odontognathus mucronatus* Lacépède).

Body elongate, much compressed; ventral outline not prominent, armed with sharp scutes; *maxillary produced* in adult, extending beyond eye to or nearly to gill-opening, shorter in young; teeth small;

scales thin, deciduous; dorsal fin small, inserted much behind origin of the long anal; *ventrals wanting.*

KEY TO THE SPECIES.

a. Anal long, its base more than half the length of body, with 65 to 68 rays; dorsal inserted about twice as far from margin of opercle as from base of caudal; ventral scutes 29.
panamensis, p. 194.

aa. Anal shorter, its base about equal to half the length of body, composed of 58 to 62 rays; dorsal inserted farther forward, not twice as far from margin of opercle as base of caudal, over about the sixteenth anal ray; ventral scutes 25 to 27.
compressus sp. nov., p. 194.

132. Odontognathus panamensis (Steindachner). (Plate XI, fig. 1.)

Pristigaster (Odontognathus) panamensis Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXIV) Ichth. Beitr., V, 1876, 24 (Panama).

Odontognathus panamensis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 438; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 41.

Head 5.1 to 6.4; depth about 4.1 to 4.25; D. 11 or 12; A. 65 to 68; scales 54 to 56.

Body elongate, very strongly compressed; the upper profile of head strongly concave above eyes; ventral profile strongly convex; the belly armed with 29 scutes; snout as long as the eye in adult, its length 4 to 4.5 in head; eye 2.9 to 3; mouth very oblique; the lower jaw but slightly projecting; maxillary very long, produced into a slender process in adult, reaching beyond the gill-opening, short and broad in young; teeth small, present on both jaws; scales large, with many concentric rings and radii; the weakly developed dorsal inserted somewhat less than twice as far from the posterior margin of opercle as from the base of caudal; anal very long, its base more than half the length of body; pectorals exceeding the length of head by an eye's diameter; sides with a narrow silvery band.

This species is represented by 2 specimens, respectively 95 and 125 mm. in length, taken at Chame Point by Mr. Robert Tweedlie. It was previously known only from the type from Panama Bay.

133. Odontognathus compressus sp. nov. (Plate XI, fig. 2.)

Type No. 79533, U. S. N. M.; length 100 mm.; Fox Bay, Colon, Panama.

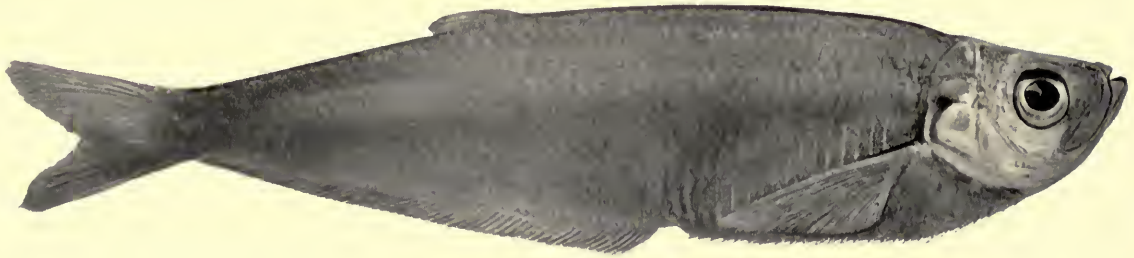

FIG. 1. ODONTOGNATHUS PANAMENSIS (Steindachner).
From a specimen 95 mm. in length.

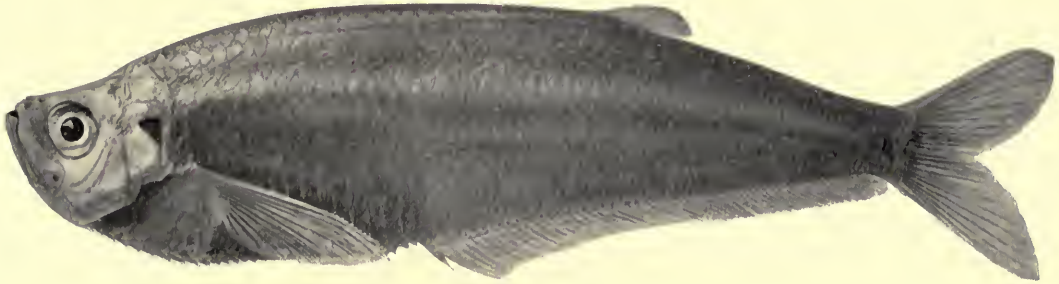

FIG. 2. ODONTOGNATHUS COMPRESSUS sp. nov.
From a paratype 97 mm. in length.

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Head 5.1 to 5.5; depth 3.5 to 3.9; D. 10 to 12; A. 58 to 62; scales about 50.

Body very strongly compressed, the upper profile of head concave, especially in larger individuals; ventral outline strongly arched anteriorly, armed with 25 to 27 strong scutes; head short; snout not quite as long as eye, its length 3.3 to 4.3 in head; eye 2.7 to 3.2; mouth very oblique, the lower jaw not greatly in advance of snout; the maxillary wide, produced in a slender process in adult which nearly or quite reaches to gill opening, its lower edge serrate, 1.2 in head in specimens 95 mm. long, 1.75 in head in specimens 55 mm. long; teeth small, present on both jaws, tongue, palatines and pterygoids; gill-rakers slender, shorter than eye, about 21 on lower limb of first arch; scales very thin, deciduous, only a few remaining on specimens at hand, their edges smooth; the dorsal very weakly developed, inserted much nearer the base of caudal than posterior margin of opercle, over about the sixteenth ray of anal; anal long and low, its base about half the length of body; pectorals longer than head, 3.95 to 4.3 in body.

Color pale translucent; the snout and back with dusky points; a trace of a narrow lateral streak present; base of caudal with a vertical dusky line; a dark point at the base of each anal ray.

Of this species there are 50 specimens, ranging from 55 to 100 mm. in length, in the present collection. It is distinguished from *O. mucronatus,* recorded from the coast of Guiana, by the much shorter anal and by the more numerous ventral scutes.

Our specimens are all from Fox Bay, Colon.

Family XXVIII. **Engraulidæ.**

The Anchovies.

Body elongate, more or less compressed; mouth very large, the maxillary usually reaching far beyond eye, frequently to gill-opening; snout pointed, usually projecting far beyond tip of mandible; eye large, placed well forward; teeth usually small and even, sometimes more or less uneven and some of them canine-like; premaxillaries not protractile; gill-membranes separate or joined, free from the isthmus; gill-rakers long and slender; pseudobranchiæ present; no lateral line; scales thin and cycloid; belly usually compressed and weakly carinate; dorsal usually about median in its position; no adipose fin; caudal forked.

KEY TO THE GENERA.

a. Gill-membranes separate and free from the isthmus.
b. Teeth all small and about equal in size. *Anchovia*, p. 196.
bb. Teeth larger, unequal, some of them slightly canine-like. *Lycengraulis*, p. 211.
aa. Gill-membranes broadly united, free from the isthmus. *Cetengraulis*, p. 212.

59. Genus **Anchovia** Jordan & Evermann.

Anchovia Jordan & Evermann, in Jordan, Proc. Cal. Ac. Sci., 2nd Ser., V, 1895, 411, and Bull. U. S. Nat. Mus., XLVII, 1896, 449 (type *Engraulis macrolepidotus* Kner & Steindachner).

Body elongate, compressed; belly usually compressed; mouth large; the maxillary usually reaching far past eye; snout conical, projecting beyond tip of mandible; scales rather large and thin, deciduous; teeth very small, present on the jaws, vomer, palatines and pterygoids; dorsal inserted about midway on body; gill-membranes separate, free from the narrow isthmus; gill-rakers long and slender.

KEY TO THE SPECIES.

a. Maxillary short and rather wide posteriorly, ending abruptly, and not reaching beyond the articulation of mandible.
b. Body rather deep, depth 3.5 to 4.0 in its length; mouth small, the gape scarcely reaching posterior margin of eye. *brevirostra* sp. nov., p. 198.
bb. Body more elongate, the depth 5.0 times or more in its length; mouth larger, the gape reaching much beyond eye.
c. Depth 5.0 to 5.4; anal rays 21 to 24. *elongata* sp. nov., p. 198.
cc. Depth 6.4 to 7.4; anal rays 16 to 19. *miarcha*, p. 199.
aa. Maxillary long, and usually narrow, reaching past articulation of mandible, frequently to gill-opening.
d. Anal fin short, with 16 to 24 rays.
e. Body elongate, depth 5.1 to 5.8 in length; pectoral fins short, not nearly reaching base of ventrals.
f. Eye large, 2.75 to 3.3 in head; postorbital part of head notably shorter than its greatest depth; teeth very minute; anal with 18 to 21 rays; sides without a well defined silvery streak. *exigua*, p. 200.
ff. Eye smaller, 3.35 to 3.9 in head; postorbital part of head equal to its greatest depth; teeth larger; anal with 16 to 18 rays; sides with a broad, well defined silvery streak. *arenicola* sp. nov., p. 201.

ee. Body deeper, the depth 4.2 to 5.1 in length; pectoral fins longer, reaching nearly or quite to base of ventrals.

g. Snout long, nearly as long as eye; cheeks long, equal to length of snout and eye, the posterior angle very acute. *naso*, p. 201.

gg. Snout short, always notably shorter than eye; cheeks short, not equal to length of snout and eye, the posterior angle only moderately acute.

h. Cheeks very short, not exceeding eye in length, the posterior angle scarcely less than a right angle; anal fin inserted under anterior third of dorsal; gill-rakers numerous, 25 to 30 on the lower limb of first arch; sides without a distinct silvery band. *parva* sp. nov., p. 202.

hh. Cheeks longer, the posterior angle notably less than a right angle; anal fin inserted under posterior third of dorsal; gill-rakers fewer, 16 to 22 on lower limb of first arch; sides with a distinct silvery band.

i. Head conical, little compressed; teeth extremely small; median line of back with a dark streak. *ischana*, p. 203.

ii. Head short, compressed; teeth slightly larger; no dark streak on median line of back. *brownii*, p. 204.

dd. Anal fin with 25 to 38 rays.

j. Gill-rakers rather few in number, fewer than 30 on lower limb of first arch.

k. Anal fin inserted under middle of dorsal, its base 3.2 to 3.8 in length of body, with 25 to 30 rays.

l. Gill-rakers few in number, only 11 to 13 on lower limb of first arch; eye small, 3.5 to 3.75 in head. *eigenmannia* sp. nov., p. 205.

ll. Gill-rakers more numerous, 18 to 22 on lower limb of first arch.

m. Body deep and much compressed, depth 3.6 to 4.0 in length. *lucida*, p. 205.

mm. Body less compressed and not as deep, depth 4.4 to 4.8 in length. *curta*, p. 206.

kk. Anal fin inserted under anterior rays of dorsal, its base 2.7 to 3.1 in length of body, with 30 to 38 rays.

n. Gill-rakers longer than eye, rather few, about 16 on lower limb of first arch; anal rays 35 to 38. *spinifera*, p. 207.

nn. Gill-rakers shorter than eye, about 20 on lower limb of first arch; anal rays usually fewer than 35.

o. Depth of body 4.1 to 4.6 in length; base of anal 2.7 to 2.9 in length of body. *panamensis*, p. 208.

oo. Depth of body 3.8 in length; base of anal 3.1 in length of body. *mundeola,* p. 208.

jj. Gill-rakers numerous, 45 or more on lower limb of first arch.

p. Body not very deep, the depth 3.3 to 4.25 in length.

q. Depth of body 4.0 (3.7 to 4.25) in length; anal with 28 (26 to 30) rays. *rastralis,* p. 209.

qq. Depth of body 3.57 (3.3 to 4.1) in length; anal with 31 (29 to 33) rays. *producta,* p. 210.

pp. Body very deep, the depth 2.8 to 3.2 in length. *macrolepidota,* p. 210.

134. Anchovia brevirostra sp. nov. (Plate XII, fig. 1.)

Type No. 79578, U. S. N. M.; length 90 mm.; Balboa, Canal Zone.

Head 4.3 to 4.6; depth 3.5 to 4.0; D. 11 to 14; A. 23 to 27; scales 35 to 40.

Body deep, compressed, the ventral outline much more rounded than the dorsal; head short; snout extremely short and blunt, not projecting greatly beyond the tip of mandible, its length 5.5 to 6.5 in head; eye 2.3 to 2.8; maxillary short and wide posteriorly, scarcely reaching articulation of mandible; mouth, unlike in other species of this genus, notably oblique, the gape scarcely reaching posterior margin of eye; posterior angle of cheek scarcely less than a right angle; opercle with short striæ; teeth present in both jaws, extremely small; gill-rakers rather short, 25 to 30 on lower limb of first arch; scales large and thin, mostly persistent; dorsal inserted about midway between anterior margin of eye and base of caudal; insertion of anal under middle of dorsal, its base 3.5 to 4.0 in length of body; pectorals reaching almost to base of ventrals, 1.05 to 1.25 in head.

Color pale silvery, without a lateral band; back with brownish points, these sometimes forming a median streak back of dorsal; caudal fin margined with black.

This species is represented by 41 specimens in the present collection, ranging in length from 60 to 100 mm. This anchovy is characterized by the very short and blunt head, small mouth, and short and wide maxillary.

Our specimens are from tide streams and the Bay at Balboa.

135. Anchovia elongata sp. nov. (Plate XII, fig. 2.)

Type No. 81768, U. S. N. M.; length 85 mm.; Mindi Cut, Canal Zone.

Head 3.6 to 3.7; depth 5.0 to 5.4; D. 12 to 14; A. 21 to 24; scales 36 to 40.

FIG. 1. ANCHOVIA BREVIROSTRA sp. nov.
From a paratype 88 mm. in length.

FIG. 2. ANCHOVIA ELONGATA sp. nov.
From a paratype 78 mm. in length.

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Body very elongate, not greatly compressed; head rather wide; posterior angle of cheek not very acute; snout rather bluntly rounded, shorter than the very large eye, its length 4.75 to 5.3 in head; eye 2.75 to 3.1; maxillary widened posteriorly, ending abruptly at articulation of mandible; minute teeth present in both jaws, directed forward; gill-rakers rather short, the longest not more than two-thirds length of eye, 17 to 22 on the lower limb of first arch; scales deciduous, only a few remaining on specimens at hand; origin of dorsal midway between anterior margin of eye and base of caudal; anal inserted under middle of base of dorsal, its base 3.9 to 4.4 in length of body; pectorals reaching base of ventrals, 1.5 to 1.7 in head.

Color pale or olivaceous; a rather ill defined silvery lateral band which is narrower than eye, usually present (almost wholly missing in one of our examples); back with dusky punctulations, some of these often arranged so as to form two parallel streaks; our largest example with punctulations on sides; a row of chromatophores along base of anal, and a dusky streak from last ray of anal to base of caudal.

We have 7 specimens of this species which range from 70 to 100 mm. in length. It is closely related to *A. cubana* (Poey), of which we have examined specimens collected and quite certainly identified by that author. The maxillary in the present species is very much shorter, it reaches only to the articulation of the mandible and is widened posteriorly. In *A. cubana* it reaches to the gill-opening and becomes narrow posteriorly, ending in a sharp point. The silvery lateral band in *A. cubana* is wider and much more sharply defined, and the eye is somewhat smaller.

Our specimens are from Mindi Cut and Porto Bello. The single specimen from the last named locality was taken by Mr. E. A. Goldman. The others were taken by us in brackish water which was very muddy.

136. Anchovia miarcha (Jordan & Gilbert).

Stolephorus miarchus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 344 (Mazatlan), and 1882, 622; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 441.

Anchovia miarcha Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 42.

Head 3.9 to 4.1; depth 6.4 to 7.4; D. 13 to 15; A. 16 to 19.

Body very elongate, little compressed; belly, unlike in other species of this genus, rounded, nowhere coming to a sharp edge; head little compressed; snout bluntly pointed, projecting for almost its whole

length beyond tip of mandible, 4.5 to 5 in head; eye 3.2 to 3.65; maxillary short, reaching articulation of mandible, there ending abruptly; minute teeth present in both jaws; gill-rakers short, about 17 on lower limb of first arch; scales lost; dorsal inserted about midway between anterior margin of eye and base of caudal; anal inserted under last rays of dorsal, its base 5.4 to 6.2 in length of body; pectorals very short, 2.4 to 2.8 in head.

Color of specimens at hand, which were preserved in formalin, pale, without silvery; no trace of a lateral band; brownish dots on top of head and on cheek; those on cheeks sometimes continued, forming a line on side of belly, and along base of anal to base of caudal.

We have 36 specimens of this species, ranging in length from 25 to 45 mm. It is characterized by the very slender body and the short maxillary.

Known from Mazatlan to the Pearl Islands. Our specimens were collected by Mr. Robert Tweedlie, at Chame Point.

137. Anchovia exigua (Jordan & Gilbert).

Stolephorus exiguus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 342 (Mazatlan); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 442.

Head 3.75 to 4.2; depth 5.1 to 5.75; D. 13 to 15; A. 18 to 21; scales 38 to 40.

Body elongate, dorsal and ventral outlines usually about evenly curved; head rather short, its postorbital portion notably shorter than its greatest depth; snout rather long and pointed, projecting beyond the tip of the mandible for at least three-fourths of its total length, 4.4 to 5.5 in head; eye 2.75 to 3.3; maxillary long and narrow, reaching to gill-opening; minute teeth, visible only with the aid of a lens, present in both jaws; gill-rakers not much shorter than eye, 19 to 25 on lower limb of first arch; scales mostly lost; origin of dorsal about midway between middle of eye and base of caudal; insertion of anal under middle of dorsal, its base 4.5 to 5.3 in length of body; pectorals short, not nearly reaching base of ventrals, 1.7 to 1.85 in head.

Color pale silvery; sides with a faint silvery streak or none; back with dusky punctulations, these most numerous at nape; base of anal with a row of dark points, these continued as a median streak from anal to base of caudal; caudal fin with dusky punctulations.

We have 62 specimens of this species, ranging in length from 55 to 75 mm. We have had the types for comparison.

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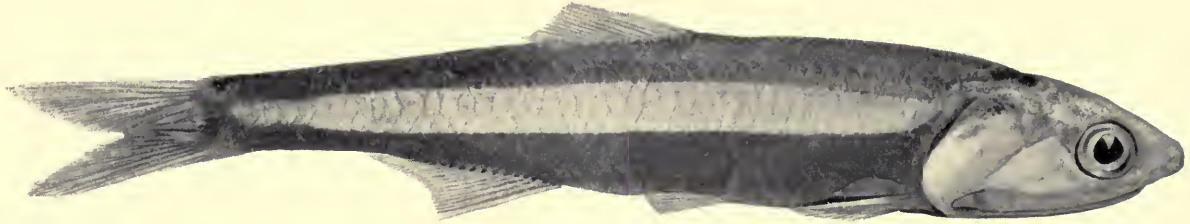

FIG. 1. ANCHOVIA ARENICOLA sp. nov.
From the type 80 mm. in length.

FIG. 2. ANCHOVIA ISCHANA (Jordan & Gilbert).
From a specimen 72 mm. in length.

Previously recorded only from Mazatlan. Our specimens are from Chame Point and Balboa.

138. Anchovia arenicola sp. nov. (Plate XIII, fig. 1.)

Anchovia ischana Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 42 (Panama; not of Jordan & Gilbert).

Type No. 81744, U. S. N. M.; length 80 mm.; Taboga Island, Panama.

Head 3.4 to 3.9; depth 5.15 to 5.8; D. 12 to 14; A. 16 to 18; scales 38 to 41.

Body very elongate, little compressed; head rather long, the post-orbital portion equal to its greatest depth; snout abruptly pointed, its length 4.3 to 5.1 in head; eye 3.35 to 3.9; opercular margin rounded; maxillary long and narrow, reaching past articulation of mandible but not quite to gill-opening; small teeth, visible without the aid of a lens, present on both jaws; gill-rakers about two-thirds length of eye, 18 to 20 on lower limb of first arch; scales deciduous, few remaining on specimens at hand; origin of dorsal about midway between anterior margin of eye and base of caudal; anal inserted under posterior fourth of base of dorsal, its base 5.4 to 6.0 in length of body; pectorals short, not nearly reaching base of ventrals, 1.75 to 2.2 in head.

Color pale silvery; sides with a sharply defined silvery band; two clusters of brownish dots, separated by a median line at nape; back with brownish punctulations, these often arranged so as to form two parallel lines, at least back of dorsal.

Numerous specimens, from 60 to 120 mm. long, were taken. This species was apparently identified as *A. ischana* by Gilbert & Pierson, which authors described the old form as new under the name *A. starksi* (Bull. U. S. Nat. Mus., XLVII, 1898, 2813). It may, however, be distinguished from this near relative by the long slender body, shorter anal, larger teeth, by the very short pectorals, and by the absence of a dark median streak on the back.

Our specimens are from Chame Point, Taboga Island, Naos Island, and Balboa. The specimens were all taken on sandy bottom.

139. Anchovia naso (Gilbert & Pierson).

Stolephorus naso Gilbert & Pierson, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2813 (Panama).

Anchovia naso Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 43 (Panama).

Head 3.3 to 3.5; depth 4.4 to 5.0; D. 12 to 15; A. 20 to 24; scales 38 to 42.

Body moderately compressed, ventral outline usually more rounded than the dorsal; head long, compressed; snout nearly as long as the eye, projecting for its full length beyond tip of mandible, 4.4 to 4.8 in head; eye 3.5 to 4.0; cheeks long, equal to snout and eye, posteriorly with a very acute angle; maxillary reaching past articulation of mandible, but not quite to gill-opening; teeth rather prominent, present at all ages; gill-rakers slender, the longest two-thirds the length of eye, about 22 on lower limb of first arch; scales thin, caducous; alimentary canal short; stomach with about 12 cæca; origin of dorsal about midway between anterior margin of eye and base of caudal; anal fin inserted slightly posterior to middle of base of dorsal, its base 4.0 to 4.9 in length of body; pectoral fin usually not quite reaching base of ventrals, 1.8 to 2.0 in head.

Color pale silvery; sides with a silvery band, which is usually well defined; in some of our larger examples the upper edge of it is sprinkled with brown points; its greatest width equals diameter of eye, becoming narrower anteriorly and on caudal peduncle; back sprinkled with brown dots, these most numerous at nape, usually forming two dotted lines back of dorsal.

Of this species 472 specimens, ranging from 40 to 85 mm. in length, were preserved. It is distinguished from related species by the long snout.

Known only from Panama Bay. Our specimens are from Chame Point, Taboga Island, Naos Island and Balboa.

140. Anchovia parva sp. nov. (Plate X, fig. 2.)

Type No. 81767, U. S. N. M.; length 55 mm.; Porto Bello, Panama.

Head 4.0 (3.7 to 4.1); depth 4.4 to 4.7; D. 11 to 14; A. 21 to 24; scales 36 to 40.

Body notably compressed; head very short; the posterior angle of cheek not much less than a right angle; snout short and compressed, its length 4.0 to 4.7 in head; eye 2.8 to 3.15; maxillary long, pointed posteriorly, reaching gill-opening; teeth very minute, present in both jaws; gill-rakers slender, the longest about as long as eye, rather numerous, 25 to 30 on lower limb of anterior arch; scales deciduous, few remaining on most of the specimens at hand; origin of dorsal about midway between middle of eye and base of caudal; anal inserted under the anterior third of base of dorsal, its base 3.8 to 4.5 in length of body; pectorals scarcely reaching ventrals, 1.4 to 1.7 in head.

Color pale; sides without silvery band, or with only a very faint trace of one; back with brownish points; nape with a quadrate blotch, which is sometimes partly or wholly divided by a median pale line; base of anal with rather faint chromatophores.

This species is represented in the present collection by 46 specimens, ranging in length from 35 to 55 mm. It is distinguished from related species by the compressed body, very short head, and numerous gill-rakers.

Our specimens are from Colon and Porto Bello, and they were mostly taken on coral reefs.

141. Anchovia ischana (Jordan & Gilbert). (Plate XIII, fig. 2.)

Stolephorus ischanus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 340 (Mazatlan).

Stolephorus starksi Gilbert & Pierson, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2813 (Panama).

Engraulis ischanus Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 1 (Rio Sabana, Darien).

Anchovia starksi Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 43 (Panama).

Head 3.5 to 3.8; depth 4.4 to 5.1; D. 13 to 15; A. 19 to 21; scales 37 to 42.

Body elongate, little compressed; ventral outline slightly more rounded than the dorsal; head rather long; snout bluntly pointed, its length 4.5 to 5.2 in head; eye 2.8 to 3.3; opercular margin rounded, without an angle at base of pectoral; posterior angle of cheek not very acute; maxillary narrow, pointed posteriorly, reaching almost to gill-opening; teeth present in both jaws, extremely small, visible only with the aid of a magnifying glass; gill-rakers slightly shorter than eye, 20 to 22 on lower limb of first arch; scales more persistent than in most species of this genus, most of them remaining on specimens at hand; origin of dorsal variable, but never posterior to a point midway between middle of eye and base of caudal; anal inserted under posterior fourth of base of dorsal, its base 4.5 to 5.7 in length of body; pectorals scarcely reaching base of ventrals, 1.6 to 1.8 in head.

Color greenish with silvery; sides with a bright silvery band; back with a prominent, median, blackish streak on its entire length; two clusters of brownish dots, separated by a median line, at nape; scales above lateral line mostly margined with dusky punctulations.

Numerous specimnes were preserved. We have for comparison the types, with which our specimens agree almost perfectly. We,

however, note that in our specimens the dorsal fin is usually inserted slightly further forward. This species is close to *A. brownii,* from which it differs mainly in the following characters: in the less compressed and more pointed head; in the more rounded opercular margin; smaller teeth; and in the presence of a distinct blackish streak along the median line of back.

Known from Mazatlan to San Miguel Bay, Panama. Our specimens are from Chame Point and Balboa.

142. Anchovia brownii (Gmelin). (Plate XIV, fig. 1.)

Atherinia brownii Gmelin, Syst. Nat., 1788, 1397 (Jamaica).

Esox epsetus Bonnaterre, Tableau Encyclo., Ichth., 1788, 175 (Jamaica).

Engraulis lemniscatus Cuvier, Règne Animal, Ed. II, II, 1829, 323 (Brazil).

Engraulis tricolor Agassiz, in Spix, Pisc. Brasil., 1829, 51 (Bahia; Para).

Engraulis piquitinga Agassiz, in Spix, Pisc. Brasil., 1829, Pl. XXIII, fig. 1 (types of *tricolor*).

Engraulis brownii (part) Cuvier & Valenciennes, Hist. Nat. Poiss., XXI, 1848, 41.

Argentina menidia Gronow, Cat. Fish, 1854, 141 (after Browne).

Engraulis hiulcus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 343 (Florida).

Stolephorus brownii Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 273.

Anchovia brownii Starks, Leland Stanford Jr. Univ. Pub., Univ. Ser., 1913, 10.

Head 3.54 (3.4 to 3.75); depth 4.2 to 4.8; D. 12 to 14; A. 19 to 22; scales 34 to 40.

Body elongate, not greatly compressed; the ventral outline more rounded than the dorsal; head rather long; snout bluntly pointed, somewhat shorter than eye, its length 4.5 to 5 in head; eye 3.3 to 3.9; maxillary becoming narrow posteriorly, reaching nearly or quite to gill-opening; minute teeth present in both jaws, directed forward; gill-rakers not much shorter than eye, 16 to 22 present on lower limb of anterior arch; scales deciduous, scarcely any remaining on specimens at hand; insertion of dorsal variable, but never posterior to a point midway between middle of eye and base of caudal; anal inserted under posterior third of base of dorsal, its base 4 to 5 in length of body; pectorals usually not quite reaching base of ventrals, 1.5 to 2.0 in head.

FIG. 1. ANCHOVIA BROWNII (Gmelin).
From a specimen 70 mm. in length.

FIG. 2. ANCHOVIA EIGENMANNIA sp. nov.
From a paratype 74 mm. in length.

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Color pale or slightly olivaceous; sides usually with a well defined silvery streak, occasionally indistinct or almost wholly wanting; top of head and back with brownish punctulations, these most numerous at nape, sometimes forming two parallel streaks along back from nape to base of caudal; anal with a row of dark dots along base.

We have 50 specimens of this species, which range in length from 55 to 100 mm.

Known from the Atlantic coast of both North and South America, from Cape Cod to Natal, Brazil. Our specimens are from Colon and Porto Bello.

143. Anchovia eigenmannia sp. nov. (Plate XIV, fig. 2.)

Type No. 79589, U. S. N. M.; length 80 mm.; Taboga Island, Panama.

Head 3.8 to 4.0; depth 4.4 to 4.8; D. 12 to 15; A. 27 to 30; scales 37 to 40.

Body moderately compressed; the back little elevated; ventral outline notably more rounded than the dorsal; snout short and blunt, projecting beyond the tip of the mandible for about two-thirds its length, 5.0 to 6.4 in head; eye 3.5 to 3.75; maxillary long and narrow, ending in a rather sharp point slightly anterior to edge of opercle; cheek rather long, the posterior angle strongly acute; teeth in the jaws rather large; gill-rakers shorter than eye, few in number, only 11 to 13 on lower limb of first arch; scales mostly lost; dorsal fin usually inserted about midway between middle of eye and base of caudal; anal inserted under middle of dorsal, its base 3.45 to 3.8 in length of body; pectorals reaching about to base of ventrals, 1.35 to 1.6 in head.

Color pale; sides with an ill defined silvery streak which is sometimes replaced by more or less dusky; back with brownish punctulations, which are most numerous at nape and often form a median streak, at least back of dorsal.

We have 15 specimens of this species, ranging in length from 75 to 85 mm. It is related to *A. lucida,* from which it differs mainly in the more elongated body, smaller eye, and in possessing fewer gill-rakers.

Our specimens are all from Taboga Island.

144. Anchovia lucida (Jordan & Gilbert).

Stolephorus lucidus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 341 (Mazatlan); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 446.

Anchovia lucida Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 42.

Head 3.6 to 3.9; depth 3.6 to 4.0; D. 12 or 13; A. 27 to 29; scales 35 to 39.

Body deep, much compressed; the ventral outline much more rounded than the dorsal; snout short and blunt, much shorter than the large eye, its length 5.3 to 6.3 in head; eye 2.8 to 3.2; maxillary rather long, reaching slightly past articulation of mandible; posterior angle of cheek only moderately acute; small teeth present in both jaws; gill-rakers short, not much more than half the length of eye, 18 to 20 on lower limb of first arch; scales moderately adherent; dorsal fin usually inserted about midway between anterior margin of eye and base of caudal; origin of anal under middle of dorsal, its base 3.3 to 3.6 in length of body; pectorals reaching about to base of ventrals, 1.4 to 1.55 in head.

Color pale silvery; sides with a more or less distinct silvery band; dorsal region with numerous brownish punctulations.

This species was not taken by us. It is here described from the type specimens, from Mazatlan, which range in length from 70 to 115 mm.

Known from Mazatlan and Panama. The Panama record is by Gilbert & Starks.

145. Anchovia curta (Jordan & Gilbert).

Stolephorus curtus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 343 (Mazatlan); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 445.

Anchovia curta Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 42.

Head 3.5 to 3.8; depth 4.4 to 4.8; D. 12 to 14; A. 25 to 29; scales 35 to 40.

Body moderately elongate, compressed; ventral outline more rounded than the dorsal; head moderate; snout short and rather blunt, extending for its whole length beyond the tip of the mandible, 4.5 to 5.5 in head; eye 4.4 to 4.8; maxillary long and narrow, reaching almost to gill-opening; small teeth present in both jaws; gill-rakers notably shorter than eye, 18 to 22 on lower limb of anterior arch; scales deciduous, only few remaining on specimens at hand; origin of dorsal about midway between anterior margin of eye and base of caudal; anal inserted under about middle of base of dorsal, its base 3.2 to 3.7 in length of body; pectorals reaching base of ventrals, 1.45 to 1.8 in head.

Color pale silvery; sides with an indistinct narrow silvery streak

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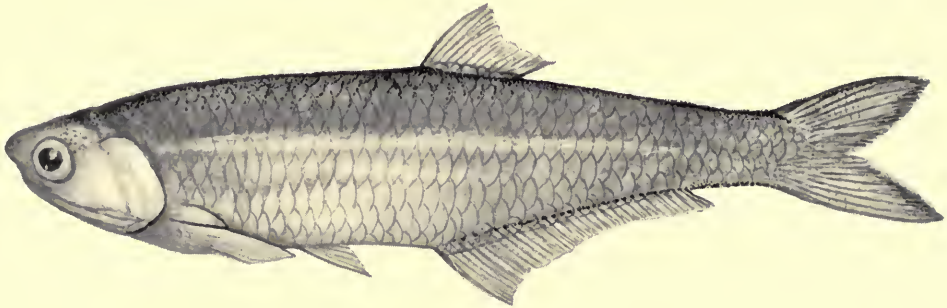

FIG. 1. ANCHOVIA PANAMENSIS (Steindachner).
From a specimen 80 mm. in length.

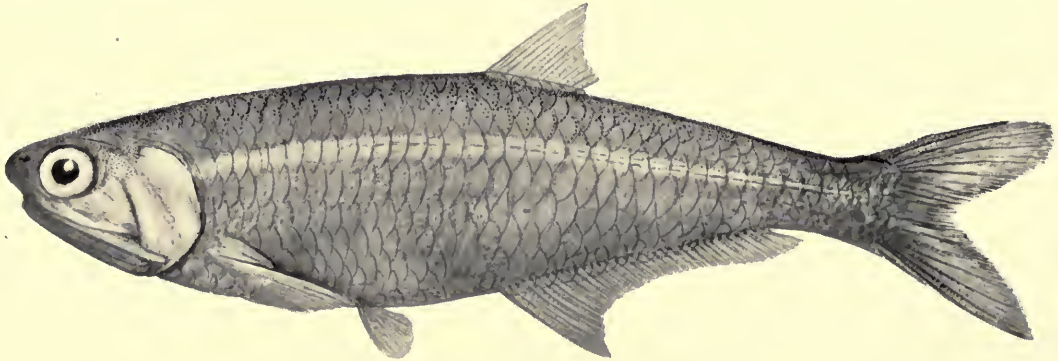

FIG. 2. ANCHOVIA MUNDEOLA (Gilbert & Pierson).
From a specimen 115 mm. in length.

or none; back with brownish points, these most numerous at nape; base of anal with a series of dark points which are usually continued back of anal to base of caudal.

The present collection contains 24 specimens, ranging from 40 to 60 mm. in length. One specimen, 50 mm. long, from Panama Bay, Balboa, we only tentatively place under this species, as it differs from the specimens here described in the longer anal, which has 33 rays. We have had the numerous types of this species for comparison and we find that our specimens average slightly fewer gill-rakers and a somewhat longer anal fin.

Known from Mazatlan to Panama. Our specimens were taken in fresh or slightly brackish muddy water in the Rio Chorrera, Rio Culebra and Rio Calobre.

146. Anchovia spinifera (Cuvier & Valenciennes).

Engraulis spinifer Cuvier & Valenciennes, Hist. Nat. Poiss., XXI, 1848, 39 (Cayenne); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXX) Ichth. Beitr., VIII, 1879, 58 (Guiana, Bahia, Panama, etc.).

Stolephorus spinifer Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 448.

Anchovia spinifera Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 46, Pl. VIII, fig. 15 (Panama).

Head 4; depth 4.1; D. 15; A. 35 to 38.

Body compressed, the abdomen strongly compressed, but not serrate; head pointed; snout strongly projecting; mouth large; the jaws with minute teeth; maxillary tapering, reaching gill-opening; gill-rakers slender, longer than eye, about 16 on lower limb of first arch; origin of dorsal an eye's diameter nearer tip of snout than base of caudal; pectorals reaching slightly beyond the base of ventrals.

Color uniform, no distinct lateral stripe. The fins are all intensively orange-yellow in life; the upper, lower and posterior margins of the caudal fin are closely punctulate with dark points.

This fish was not seen by us. The above description was compiled from published accounts. The species is recorded from Panama by Steindachner and by Gilbert & Starks.

Known from the coasts of Guiana, Brazil and the Pacific coast of Panama.

147. Anchovia panamensis (Steindachner). (Plate XV, fig. 1.)

Engraulis panamensis Steindachner, (Sitzb. k. Akad. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 39 (Panama).

Stolephorus panamensis Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 109, and Proc. U. S. Nat. Mus., 1882, 622; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 448.

Anchovia panamensis Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 44 (Panama).

Head 3.9 to 4.6; depth 4.1 to 4.6; D. 12 to 14; A. 30 to 36; scales 38 to 43.

Body much compressed, rather deep; the ventral outline more rounded than the dorsal; snout shorter than eye, projecting for nearly its whole length beyond tip of mandible, 4.7 to 6.5; eye 3.0 to 3.5 in head; maxillary narrowed posteriorly, variable in length, usually reaching slightly past articulation of mandible, occasionally to gill-opening; teeth in the jaws small, persistent; gill-rakers shorter than eye, about 20 on lower limb of anterior arch, not increasing in number with age; alimentary canal short; dorsal and anal fins with scaly sheath; origin of dorsal about midway between middle of eye and base of caudal; origin of anal under anterior rays of dorsal; base of anal long, 2.7 to 2.9 in length of body; pectorals reaching to or past base of ventrals, 1.15 to 1.35 in head.

Color pale silvery, with dusky punctulations on head and back; a silvery lateral band present, which is notably narrower than eye; base of anal with a row of dusky chromatophores.

Of this species 55 specimens from 60 to 100 mm. in length were taken. It is very closely related to *A. compressa,* from which it may, however, be distinguished by the much narrower lateral band, shorter head, and fewer gill-rakers.

Known from the Pacific coast of tropical America. Our specimens are from Panama Bay, Balboa.

148. Anchovia mundeola (Gilbert & Pierson). (Plate XV, fig. 2.)

Stolephorus mundeolus Gilbert & Pierson, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2812 (Panama).

Anchovia mundeola Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 44 (Panama).

Head 4.2; depth 3.8; D. 13; A. 32; scales 38.

Body much compressed, deep; the ventral outline more rounded than the dorsal; head rather long; snout shorter than the large eye, its length 5.5 in head; eye 3.3; tip of mandible slightly in advance of eye; maxillary reaching to gill-opening; teeth in the jaws small, persistent; gill-rakers shorter than eye, about 20 on lower limb of first arch; dorsal and anal with scaly sheath; origin of dorsal midway

between middle of eye and base of caudal; origin of anal under anterior rays of dorsal; base of anal rather short, 3.1 in length of body; pectorals reaching base of ventrals, 1.35 in head.

Color pale silvery, with dusky punctulations on head and back; a very narrow and rather indistinct, silvery, lateral band present.

We have a single specimen, 120 mm. long, which we assign to this species. It is distinguished from *A. panamensis* by the notably deeper body and shorter anal base, and by the larger eye. In our largest specimens, 100 mm. long, of *A. panamensis* the eye measures 3.5 in head, while in our much larger specimen of *A. mundeola* it measures only 3.3 in head.

Known only from Panama Bay. Our specimen is from a tide pool at Balboa.

149. Anchovia rastralis (Gilbert & Pierson).

Stolephorus rastralis Gilbert & Pierson, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2811 (Panama).

Anchovia rastralis Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 42, Pl. VIII, fig. 14 (Panama).

Head 3.2 to 3.4; depth 3.7 to 4.25; D. 12 to 14; A. 26 to 30; scales 36 to 40.

Body much compressed; belly carinate; head shaped as in *Cetengraulis,* but not as long; cheeks with a very acute posterior angle; snout much shorter than eye, projecting for its whole length beyond tip of mandible, 4.8 to 6.2 in head; eye 3.0 to 3.5; maxillary reaching past articulation of mandible, but not quite to gill-opening; teeth small; gill-rakers very slender, the longest not much shorter than eye, numerous, about 50 on lower limb of anterior arch in specimens 60 mm. long; scales large and thin, caducous, few remaining on specimens at hand; origin of dorsal variable, usually about midway between anterior margin of eye and base of caudal; anal inserted under middle of dorsal, its base 3.45 to 3.8 in length of body; pectorals reaching base of ventrals, 1.75 to 2.0 in head.

Color pale or slightly olivaceous; sides with a somewhat ill defined silvery band; back with brownish punctulations, which often form two parallel lines, at least back of dorsal fin.

We have 25 specimens of this species, ranging from 40 to 70 mm. in length. We have also examined several of the cotypes. This species is very closely related to *A. producta,* from which we separate it with difficulty.

Known from the Pacific coast of Panama. Our specimens are from the tide streams at Corozal and Balboa.

150. Anchovia producta (Poey).

Engraulis productus Poey, Repertorio, 1866, 380 (Cuba).

Stolephorus productus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 447.

Head 3.2 to 3.5; depth 3.3 to 4.1; D. 13 or 14; A. 29 to 33; scales 38 to 44.

Body compressed; ventral outline more strongly curved than dorsal; belly compressed but not serrate; head compressed; snout very short, much shorter than eye, its length 5.3 to 9.5 in head; eye 3 to 4.1; maxillary long, ending in a rather sharp point slightly beyond articulation of mandible; teeth very minute; gill-membranes separate, free from the isthmus; gill-rakers long, about equal to length of eye in specimens 130 mm. long, shorter in young, serrate on sides, the serræ fitting together like cogs on a wheel, about 100 on lower limb of anterior arch in specimens 130 mm. long; scales thin, cycloid, more or less caducous; stomach with about 12 cæca; intestine short; dorsal and anal fins with a scaly sheath at base; the anal long, its origin under middle of dorsal; caudal deeply forked, the lower lobe the longer; ventrals very small, placed close together near ventral edge; pectorals moderate, usually reaching base of ventrals, 1.7 to 1.85 in head.

Color greenish above; silvery on sides; young usually with an ill defined silvery lateral band.

We have 54 specimens of this species, ranging in length from 60 to 175 mm. We have, besides these, examined specimens from Jamaica.

Known from Cuba, Jamaica and Panama. Our material is from Mindi Cut, Colon market and Porto Bello.

151. Anchovia macrolepidota (Kner & Steindachner).

Engraulis macrolepidotus Kner & Steindachner, Abh. k. Bayer. Ak. Wiss., X, 1864 (1865), 21, Pl. III, fig. 2 (Rio Bayano, Panama); Steindachner, (Sitzb. k. Akad. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 37.

Stolephorus macrolepidotus Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 109.

Anchovia macrolepidota Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 449; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 47 (Panama); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 81 (Panama).

Head 3 to 3.5; depth 2.8 to 3.2; D. 12 to 14; A. 27 to 31; scales 37 to 40.

Body rather short, and deep, becoming deeper with age; the ventral outline much more rounded than the dorsal; snout very short, much shorter than eye, projecting almost its full length beyond the tip of the mandible, 8.3 to 10 in head; eye 3.8 to 4; maxillary narrowed posteriorly, variable in length, reaching from slightly past articulation of mandible to gill-opening; teeth in the jaws very minute, persistent even in adult; gill-rakers long and slender, nearly equal to length of eye, about 95 on the lower limb of first arch; scales thin, caducous; alimentary canal short; stomach with about 12 pyloric cæca; dorsal and anal fins with a scaly sheath; origin of dorsal slightly nearer base of caudal than tip of snout; anal fin long, its origin under middle of base of dorsal; caudal fin deeply forked, the lower lobe slightly the longer; pectoral fins reaching about to base of ventrals, 1.55 to 1.9 in head.

Color bluish green above; mostly silvery on sides, without a lateral band.

We have 4 specimens of this species, ranging from 16.5 to 190 mm. in length.

Known from the Gulf of California south to Panama. Our specimens are from tide streams at Balboa, and from the Panama market.

60. Genus **Lycengraulis** Günther.

Lycengraulis Günther, Cat. Fish. Brit. Mus., VII, 1868, 385 (type *Engraulis grossidens* Cuvier).

This genus differs from *Anchovia* in having larger teeth in the jaws, which are more or less unequal in size, some of them being canine-like.

152. Lycengraulis poeyi (Kner & Steindachner).

Engraulis poeyi Kner & Steindachner, Abh. k. Bayer. Ak. Wiss., X, 1864 (1865), 23, Pl. III, fig. 3 (Rio Bayano, Panama).

Stolephorus poeyi Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 445.

Lycengraulis poeyi Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 49 (Panama).

Head 4.25 to 4.4; depth 4 to 4.5; D. 13 to 15; A. 22 to 23; scales 40 to 43.

Body elongate, compressed; the ventral outline more rounded than the dorsal; snout very short, much shorter than eye, its length 6.2 to 8 in head; eye 3.3 to 4.4; maxillary long, reaching slightly past articulation of mandible, occasionally nearly to gill-opening; teeth in the lower jaw more or less unequal; those in the upper jaw smaller, more even in size, and more numerous; gill-rakers rather short and strong, much shorter than eye, 14 or 15+18 to 20 on anterior arch, apparently not increasing in number with age; scales very thin, caducous; alimentary canal short; stomach with numerous pyloric cæca; dorsal and anal fins with a scaly sheath; anal fin long, its origin under middle of base of dorsal; caudal forked, the lower lobe longer; pectorals moderate, usually reaching the base of the small ventrals, 1.2 to 1.38 in head.

Color bluish green above; sides silvery; our smallest specimen with a very wide lateral band, absent in larger examples.

Of this species 17 specimens, ranging from 135 to 230 mm. in length, were obtained. We have compared these specimens with a single specimen of *L. grossidens* from Bahia, Brazil. The latter apparently very closely related species seems to have the teeth in the jaws more uneven and further apart.

Known only from Panama Bay. Our spcimens are from tide streams and a sandy beach at Balboa, and from the Panama market.

61. Genus **Cetengraulis** Günther.

Cetengraulis Günther, Cat. Fish. Brit. Mus., VII, 1868, 383 (type *Engraulis edentulus* Cuvier).

The gill-membranes broadly united, free from the isthmus; gill-rakers long and slender; teeth minute.

KEY TO THE SPECIES.

a. Head long, 2.75 to 2.9 in body; depth 3.45 to 4.15.
mysticetus, p. 212.

aa. Head shorter, 3 to 3.3 in body; depth 2.9 to 3.6.
edentulus, p. 214.

153. Cetengraulis mysticetus (Günther).

Engraulis mysticetus Günther, Proc. Zoöl. Soc. London, 1866, 604 (Panama).

Cetengraulis mysticetus Günther, Cat. Fish. Brit. Mus., VII, 1868, 383; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 47 (Panama).

Stolephorus opercularis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 275 (Punta San Felipe, Gulf of Cal.); Gilbert, Proc. U. S. Nat. Mus., 1890, 449.

Cetengraulis engymen Gilbert & Pierson, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2815 (Panama); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 48 (Panama).

Anchovia opercularis Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 42.

Head 2.75 to 2.9; depth 3.45 to 4.15; D. 14 to 17; A. 21 to 23; scales 42 to 45.

Body rather deep, compressed, growing deeper with age; belly trenchant, but not carinate or serrate; head compressed, opercles long; snout very short, much shorter than eye, its length 7.5 to 10 in head; eye 4.5 to 5.65; teeth minute; gill-membranes broadly united, wholly free from the isthmus; gill-rakers long, becoming proportionately much longer and more numerous with age, equal to length of eye in young, about twice length of eye in adult; specimens 50 mm. long with about 22 gill-rakers on upper limb of anterior arch and 28 on lower limb, examples 80 mm. long with about 40 on upper and 43 on lower, those 140 mm. long with about 58 on upper and 57 on lower; scales cycloid, very thin and more or less caducous; stomach with about 14 cæca; intestine very long, with numerous convolutions; dorsal and anal with a scaly sheath; caudal forked, the lower lobe slightly the longer; ventrals very small; pectorals rather short, not quite reaching origin of ventrals, 2.15 to 2.6 in head.

Color olivaceous above, silvery on sides and below; young with a silvery lateral band, which disappears in specimens about 85 mm. in length.

We have several hundred specimens of this species, but only on two occasions were they taken in great abundance. We have examined the type of *Stolephorus opercularis* Jordan & Gilbert, and we are convinced that it is *C. mysticetus* with the gill-membranes broken. The membranes are still present and may be lifted with dissecting needles so as to fit together.

Known from the Pacific coast of Central America, Punta San Felipe to Panama. Our specimens are from Chame Point, Naos Island, Balboa and Panama market.

154. Cetengraulis edentulus (Cuvier).

Engraulis edentulus Cuvier, Règne Animal., Ed. II, II, 1829, 323 (Jamaica).

Engraulis brevis Poey, Repertorio, I, 1866, 379 (Cuba).

Cetengraulis edentulus Günther, Cat. Fish. Brit. Mus., VII, 1868, 383.

Cetengraulis brevis Swaín & Meek, Proc. Ac. Nat. Sci. Phila., 1884, 35.

Stolephorus garmani Evermann & Marsh, Rept. U. S. Fish Comm., 1899 (1900), 352 (Puerto Real, Porto Rico), and Bull. U. S. Fish Comm., XX, Pt. I, 1900 (1902), 89, fig. 14.

Stolephorus gilberti Evermann & Marsh, Rept. U. S. Fish Comm., 1899 (1900), 352 (Palo Seco, Porto Rico), and Bull. U. S. Fish Comm., XX, Pt. I, 1900 (1902), 90, fig. 15.

Head 3 to 3.3; depth 2.9 to 3.6; D. 14 to 16; A. 21 to 24; scales 40 to 43.

Body deep, compressed, growing deeper with age; back, in front of dorsal, strongly compressed, coming to a sharp edge; belly strongly compressed, but not carinate or serrate; head rather short; opercles of moderate length; snout very short, much shorter than eye, its length 5.5 to 8.3 in head; eye 3.4 to 3.8; teeth minute; gill-membranes broadly united, free from the isthmus; gill-rakers numerous, long and slender, proportionately larger in adult; scales cycloid, more or less caducous; dorsal and anal fins with a scaly sheath at base; caudal forked; the lower lobe slightly the longer; ventrals very short; pectorals moderate, not quite reaching ventrals, 1.9 to 2.25 in head.

Color olivaceous above, silvery on sides and below; young with a silvery lateral band.

Only two specimens, respectively 50 and 30 mm. long, were taken. The above description is based on these and several specimens from Jamaica and Rio Janeiro, Brazil. We have also examined the types of *Stolephorus garmani* Evermann & Marsh, and *Stolephorus gilberti* Evermann & Marsh. Both undoubtedly belong to the genus *Cetengraulis*. The gill-membranes are broken, but still present, and many be lifted with dissecting needles so as to extend across the isthmus. According to our measurements both readily fall within the range of the present species. This species is very closely related to *C. mysticetus,* from which it differs in the somewhat shorter head and deeper body.

Known from the West Indies to Brazil. Our specimens are from the Colon market and Fox Bay, Colon.

Order X. Iniomi.

Family XXIX. Synodontidæ.

The Lizard-fishes.

Body oblong or elongate, little, if at all, compressed; head blunt or pointed; mouth very large, the entire margin of upper jaw formed by the premaxillaries; maxillaries rudimentary or wanting, closely adherent to the premaxillaries if present; opercular bones thin but complete; gill-membranes mostly separate, free from the isthmus; branchiostegals usually numerous; gill-rakers small or obsolete; pseudobranchiæ present; teeth mostly cardiform on both jaws, tongue and palatines; canines rarely present, large teeth usually depressible; no barbels; scales usually present, cycloid; lateral line present; alimentary canal short; air bladder small or wanting; eggs enclosed in the sacs of the ovary and extruded through an oviduct; dorsal fin short, with soft rays only; adipose fin present, rarely obsolete; pectoral and ventral fins present; anal fin moderate or long; caudal fin forked; the skeleton rather well ossified; sides sometimes with phosphorescent spots or photophores. Most of the species of this family inhabit sandy shores; some of them descend to the depths of the ocean.

KEY TO THE GENERA.

a. Body very elongate, terete or subterete; head long, more or less depressed; snout long, triangular, notably longer than eye. *Synodus*, p. 215.

aa. Body stouter, somewhat compressed; head short, compressed; snout very short and blunt, notably shorter than eye. *Trachinocephalus*, p. 222.

62. Genus **Synodus** Scopoli.

Synodus Scopoli, Intro. Hist. Nat., 1777, 449 (type *Esox synodus* Linnæus).

Tirus Rafinesque, Caratteri, etc., 1810, 56 (type *Tirus marmoratus* Rafinesque= *Esox synodus* Linnæus).

Saurus Cuvier, Règne Animal, Ed. I, II, 1817, 169 (type *Salmo saurus* Linnæus).

Alpismaris Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 458 (type *Alpismaris risso* Risso).

Laurida Swainson, Nat. Hist. & Class. Fish., II, 1839, 287 (type *Salmo fœtens* Linnæus).

Body elongate, terete; head more or less depressed; snout triangular, usually rather pointed; mouth very large; premaxillaries very long, more than half the length of head, not protractile; maxillaries, if present, very small and closely connected with the premaxillaries; teeth in the premaxillaries large, compressed, with sharp cutting edges, depressible, in one or two series; lower jaw with a band of similar teeth, the inner and larger ones depressible; tongue, palatines and hyoid bone all provided with depressible teeth; first superior pharyngeal cartilaginous, the second without teeth, the third and fourth separate, with teeth; lower pharyngeals separate; gill-rakers minute, spine-like; pseudobranchiæ well developed; gill-membranes slightly connected; branchiostegals 12 to 16; scales rather small, cycloid, covering body, cheek and opercles; top of head naked; lateral line present; dorsal fin anterior; caudal forked, rather short; anal short, posterior in its position; ventrals long, not far behind pectorals; pectorals moderate, inserted high; stomach with a long blind sac and many pyloric cæca; skeleton rather firm.

KEY TO THE SPECIES.

a. Scales large, 43 to 52 in lateral series; lateral line with a blunt keel posteriorly.

b. Anterior rays of dorsal fin not reaching tips of succeeding rays when deflexed; lower jaw rounded anteriorly, not ending in a fleshy knob or point; shoulder girdle with an evident black blotch just back of upper anterior angle of opercle; dorsal and caudal fins with dark bars; lining of gill-covers pale.
intermedius, p. 217.

bb. Anterior rays of dorsal reaching to or past succeeding rays when deflexed; lower jaw ending in a fleshy point or knob; shoulder girdle without an evident black blotch; dorsal and caudal without bars.

c. Pectoral fins short, reaching only slightly past base of ventrals, 2.0 to 2.15 in head; ventral fins long, only slightly shorter than head, reaching more than half the distance from their base to origin of anal; lining of gill-covers pale. *poeyi*, p. 218.

cc. Pectoral fins long, reaching past base of ventrals to about the middle of these fins, 1.45 to 1.75 in head; ventral fins short, slightly shorter than postorbital part of head, reaching not more than half the distance from their base to origin of anal; lining of gill-covers dusky. *evermanni*, p. 219.

aa. Scales small, 57 to 66 in lateral series; lateral line without a keel.

d. Dorsal fin inserted slightly nearer tip of snout than adipose fin; anal fin short, with 8 or 9 rays, its base contained 2.65 to 3.0 in head; snout short and rounded, 4.5 to 4.6 in head.
lacertinus, p. 220.

dd. Dorsal fin inserted about midway between anterior margin of eye and adipose fin; anal fin with 10 to 14 rays, the base 1.4 to 2.4 in head; snout long and rather pointed, 3.1 to 3.8 in head.

e. Anal fin with 10 or 11 rays, rarely with 12, the usual number being 11; head large, 4.16 (4.05 to 4.3) in length.
fœtens, p. 220.

ee. Anal with 12 to 14 rays, rarely with only 11, the usual number being 13; head somewhat smaller, 4.42 (4.2 to 4.6) in length.
scituliceps, p. 221.

155. Synodus intermedius (Agassiz).

Saurus intermedius Agassiz, in Spix, Pisc. Brasil., 1829, 81 (Brazil).

Saurus anolis Cuvier & Valenciennes, Hist. Nat. Poiss., XXII, 1849, 483 (Bahia; Martinique).

Synodus intermedius Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 889; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 535.

Head 3.6 to 4.2; depth 7.6 to 8.7; D. 11 or 12; A. 10 to 12; scales 48 to 52.

Body very elongate, terete; head depressed above, slightly wider than deep; interorbital space notably concave, 5.4 to 9.0 in length of head; snout short and not very pointed, not protruding, 4 to 4.5 in head; eye 4.5 to 5.6; lower jaw rounded anteriorly, not ending in a fleshy knob; mouth large, premaxillaries reaching far past eye, 1.6 in length of head; gill-rakers minute, bristle-like; pseudobranchiæ large; scales rather large, striate, with smooth membranous border; lateral line prominent, with a blunt keel posteriorly; dorsal fin high, the longest rays about equal to length of head without snout, the anterior rays not reaching past the tips of any of the succeeding rays when the fin is deflexed, its outer margin slightly convex, inserted slightly nearer tip of snout than adipose fin; caudal fin forked, as long as head without snout; anal fin low, its base 1.5 to 1.8 in length of head; ventral fins very long, equal to length of head, reaching about three-fifths of the distance from their base to origin of anal; pectoral fins short, reaching to or slightly past base of ventrals, 1.95 to 2.2 in head.

Color brownish above; pale below; back and sides with about 8 cross-bands, these occasionally alternating with indistinct ones; a jet black blotch on shoulder girdle, just back of upper anterior angle of opercle; lining of gill-covers pale; ventrals and anal pale, other fins dusky; dorsal and caudal with evident bars.

This species was not taken by us. It is here described from specimens from Florida, Bermuda and Cuba, ranging in length from 175 to 280 mm.

Its range extends from North Carolina to Brazil.

156. Synodus poeyi Jordan.

Synodus intermedius Poey, Enumeratio, 1875, 143 (not of Agassiz); Meek, Proc. Ac. Nat. Sci. Phila., 1884, 132 (not of Agassiz).

Synodus poeyi Jordan, Proc. U. S. Nat. Mus., 1886, 526 (Havana); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 536.

Head 3.5 to 3.9; depth 6.7 to 7.85; D. 10 or 11; A. 9 to 11; scales 43 to 48.

Body elongate, cylindrical; head depressed above, wider than deep; interorbital concave, 7.5 to 8.8 in length of head; snout short and wide, quite as wide as long, 4 to 4.45 in head; eye 3.7 to 4.45; lower jaw slightly in advance of the upper, ending in a very small fleshy point; mouth large, premaxillaries reaching far past eye, 1.55 to 1.75 in head; gill-rakers minute, bristle-like; pseudobranchiæ large; scales large, striate, with smooth membranous edges; lateral line prominent, with a slight keel posteriorly; dorsal fin rather high, its longest rays equal to length of head without snout; the anterior and posterior rays coterminal when deflexed, its anterior margin straight, inserted about midway between tip of snout and adipose fin; caudal forked, as long as head without snout; anal fin low, inserted posteriorly, its base 2.25 to 2.7 in head; ventral fins only slightly shorter than head, reaching notably more than half the distance from their base to anal; pectorals rather short, reaching only slightly past the base of ventrals, 2.0 to 2.15 in head.

Color grayish above; pale below; back with about 4 more or less distinct cross-bars; sides, along lateral line, with about 8 dark blotches; lining of gill-covers mostly pale; shoulder gridle without a black blotch; ventrals and anal pale; other fins more or less dusky, but without trace of bars; adipose fin mostly black.

We have 16 specimens of this species, ranging from 60 to 85 mm. in length. It is closely related to *S. intermedius,* from which it differs mainly in the shape of the dorsal fin and in color.

Known heretofore only from Cuba. Our specimens are from Fox Bay, Colon; and Porto Bello.

157. Snyodus evermanni Jordan & Bollman.

Synodus evermanni Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 152 (Panama Bay, in 33 fathoms); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 535; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 49 (Panama Bay).

Head 3.4 to 3.7; depth 6.65 to 8.5; D. 10 or 11; A. 10 or 11; scales 43 to 50.

Body very elongate, fusiform; head depressed above, its width equal to its depth; interorbital space slightly concave, 5.0 to 6.0 in length of head; snout rather short and not very pointed, not much protruding, if any, 3.75 to 4.5 in head; eye 4 to 5.8; lower jaw ending in a fleshy knob; mouth large, the premaxillaries reaching far past eye, 1.55 to 1.7 in head; gill-rakers very short and slender, bristle-like; pseudobranchiæ well developed; scales rather large, striate, with smooth membranous edges; lateral line prominent, posteriorly with a slight keel; dorsal fin rather high, the longest rays slightly shorter than postorbital part of head, the anterior rays reaching past the tips of the succeeding rays when the fin is deflexed, outer margin of fin slightly concave, inserted somewhat nearer the adipose fin than tip of snout; caudal fin forked, rather short, as long as postorbital part of head; anal fin posteriorly placed, its base 2.2 to 2.75 in head; ventral fins rather short, not quite as long as postorbital part of head, reaching half the distance from their base to origin of anal, pectoral fins long, reaching past base of ventrals to about the middle of these fins, 1.45 to 1.75 in head.

Color brownish above; pale below; the body without evident cross-bars; sides with about 8 dark blotches along lateral line; lining of gill-covers dusky; ventrals and anal pale, other fins more or less dusky, but without bars; adipose fins and inner rays of caudal mostly black.

This species was not taken by us, but a small specimen, 40 mm. in length, was sent by Mr. Robert Tweedlie. It was also dredged in Panama Bay by the Albatross in 33 fathoms of water. It is here described from 12 specimens, of the type lot, and from 4 specimens dredged by the Albatross in the Gulf of California, and the small specimen sent by Mr. Tweedlie. It is very closely related to *S. poeyi*, but its ventral fins are shorter, and its pectoral fins notably longer.

Known from Lower California to Panama. The specimen at hand is from Chame Point.

158. Synodus lacertinus Gilbert.

Synodus lacertinus Gilbert, Proc. U. S. Nat. Mus., 1890, 55 (Acapulco); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 536.

Head 3.65 to 4.1; depth 5.9 to 6.5; D. 11 or 12; A. 8 or 9; scales 59 to 63.

Body slightly compressed, deeper than wide; head as wide as deep; interorbital concave, 9.5 to 10 in head; snout rather short and not very pointed, its length equal to its width, not protruding, 4.5 to 4.6 in head; eye 5.3 to 6.8; lower jaw without a fleshy knob at the tip; mouth large, the premaxillaries reaching far beyond eye, 1.55 to 1.6 in head; gill-rakers undeveloped; pseudobranchiæ large; scales rather small, with membranous border; lateral line without a keel; dorsal fin moderate, the anterior rays not reaching past the tips of the succeeding rays when deflexed, inserted slightly nearer tip of snout than adipose fin; caudal forked, as long as head without snout; anal fin posteriorly placed, its base 2.65 to 3.0 in head; ventral fins long, reaching more than half the distance from their base to origin of anal; pectorals very short, reaching but slightly past base of ventrals, 2.1 to 2.4 in head.

Color dark brown above; pale below; back and sides with about 5 black cross-bars; mandible below with brown bars; lining of gill-covers pale; ventrals and anal pale; dorsal and caudal faintly barred.

This species was not taken by us. In the National Museum collection, however, occurs a specimen, 150 mm. long, taken in Panama by J. M. Dow, which we identify as this species. This specimen, and the type from Acapulco, which is also 150 mm. long, form the basis for the above description, and are apparently the only representatives of the species that are known.

Known from Acapulco to Panama.

159. Synodus fœtens (Linnæus).

Salmo fœtens Linnæus, Syst. Nat., Ed. XII, 1766, 513 (South Carolina).

Osmerus albidus Lacépède, Hist. Nat. Poiss., V, 1803, 229 (Carolina; after Linnæus).

Coregonus ruber Lacépède, Hist. Nat. Poiss., V, 1803, 263 (Martinique; after Plumier).

Esox salmoneus Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 442 (New York).

Saurus longirostris Agassiz, in Spix, Pisc. Brasil., 1829, Pl. XLIII (Brazil).

Saurus mexicanus Cuvier, Règne Animal, Ed. II, II, 1829, 314 (Mexico).
Saurus spixianus Poey, Memorias, II, 1861, 304 (Cuba).
Saurus fœtens Günther, Cat. Fish. Brit. Mus., V, 1864, 396.
Synodus spixianus Poey, Syn. Pisc. Cub., 1868, 141.
Synodus fœtens Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 280; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 538, Pl. LXXXVIII, fig. 538.

Head 4.05 o 4.3; depth 6.8 to 8.7; D. 10 to 12; A. 10 to 12; scales 58 to 63.

Body very elongate, fusiform; head depressed above, wider than deep; interorbital space slightly concave, 5.2 to 9.2 in head; snout long and pointed, projecting beyond lower jaw, 3.25 to 3.8 in head; eye 4.7 to 7.7; mouth very large, the premaxillary reaching far beyond eye, 1.5 to 1.7 in head; gill-rakers undeveloped; pseudobranchiæ large; scales small, striate, with smooth membranous border; lateral line well marked, but without a keel; dorsal fin high, inserted slightly nearer anterior margin of eye than adipose fin; caudal fin forked; the upper lobe the longer; anal fin posteriorly placed, its base 1.6 to 2.4 in head; ventral fins long, usually about as long as head without snout, occasionally equal to length of head; pectorals short, not reaching ventrals, 1.95 to 2.35 in head.

Color grayish, with more or less greenish in life, above; pale below; the young with more or less distinct cross-bars on back; anal and ventrals pale; other fins more or less dusky.

The present collection contains 31 specimens of this species, ranging from 55 to 300 mm. in length.

Known from Cape Cod to Brazil. Our specimens are from Fox Bay, Colon; Colon market; and Mindi Cut.

160. Synodus scituliceps Jordan & Gilbert.
Synodus scituliceps Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 344 (Mazatlan); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 537; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 50 (Panama Bay).
Synodus jenkinsi Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 153 (Panama Bay; Galapagos Islands).

Head 4.2 to 4.6; depth 7.0 to 9.5; D. 10 or 11; A. 11 to 14; scales 57 to 66.

Body elongate, terete; head depressed above, wider than deep; interorbital space slightly concave, 5.4 to 12 in length of head; snout

long and narrow, projecting beyond lower jaw, 3.1 to 3.6 in head; eye 3.8 to 7.25; mouth very large, the premaxillary reaching much beyond eye, 1.4 to 1.65 in head; gill-rakers undeveloped; pseudobranchiæ large; scales small, striate, with membranous border; lateral line well marked, but without a keel; dorsal fin high, inserted about midway between anterior margin of eye and adipose fin; caudal fin forked, the upper lobe slightly the longer; anal fin rather low, posteriorly placed, its base 1.4 to 2.0 in head; ventral fins rather long, usually about as long as head without snout; pectorals rather short, not reaching base of ventrals, 1.75 to 2.15 in head.

Color grayish above, pale below; young with more or less distinct cross-bars on back; anal and ventrals pale; other fins more or less dusky.

This species is represented by 38 specimens in the present collection, which range in length from 45 to 415 mm. It is very closely related to *S. fœtens,* from which it can scarcely be separated. The anal fin is, however, slightly longer, its usual number of rays being 13, rarely with only 11. The usual number for *fœtens* is 11, rarely with 12. The head in the former is slightly smaller. In a series of 8 specimens the average length of head in body is 4.42+. In a series of 8 of like size of *fœtens* it is 4.16+.

Known from the Gulf of California to the Galapagos Islands. Our specimens are from Chame Point, Taboga Island, Balboa and Panama market.

63. Genus **Trachinocephalus** Gill.

Trachinocephalus Gill, Proc. Ac. Nat. Sci. Phila., 1861, 53 (type *Saurus myops* Cuvier & Valenciennes; name only; first defined by Jordan, Proc. U. S. Nat. Mus., 1890, 314).

Closely related to *Synodus.* Body stout and somewhat compressed; head short, blunt and compressed; snout shorter than eye; vent well forward, under tip of last dorsal ray.

161. Trachinocephalus myops (Forster).

Salmo myops Forster, MS., Bloch & Schneider, Syst. Ichth., 1801, 421 (St. Helena).

Osmerus lemniscatus Lacépède, Hist. Nat. Poiss., V, 1803, 236 (Martinique; after Plumier).

Saurus truncatus Agassiz, in Spix, Pisc. Brasil., 1829, 82 (Brazil).

?Salmo trachinus Schlegel, Fauna Japon., Poiss., 1842, 231 (Japan).

?Saurus limbatus Eydoux & Souleyet, Voy. Bonito, Poiss., 1853, 199.

Saurus brevirostris Poey, Memorias, II, 1861, 305 (Cuba).

Trachinocephalus myops Gill, Proc. Ac. Nat. Sci. Phila., Supplement, 1861, 53 (name only); Jordan, Proc. U. S. Nat. Mus., 1890, 314; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 533, Pl. LXXXVIII, fig. 235.

Saurus myops Günther, Cat. Fish. Brit. Mus., V, 1864, 398.

Synodus myops Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 281.

Head 3.4 to 4.1; depth 5.0 to 5.75; D. 11 to 14; A. 13 to 16; scales 51 to 56.

Body slightly compressed; head compressed, rough above; interorbital space narrow, deeply concave, 8.9 to 11.0 in length of head; snout very short and blunt, shorter than eye, 7.1 to 11 in head; eye 4.35 to 6.5; mouth large, terminal; premaxillary long, reaching nearly to margin of preopercle, 1.6 to 1.8 in head; gill-rakers minute, spine-like; pseudobranchiæ large; scales with smooth membranous edges, their surface rough, more or less striate; lateral line prominent, with a slight keel posteriorly; dorsal fin rather high, inserted slightly nearer tip of snout than adipose fin; caudal fin rather long, deeply forked; anal low and long, its base 1.0 to 1.25 in head; ventrals very long, nearly equal to length of head; pectorals short, reaching only slightly past base of ventrals, 1.9 to 2.4 in head.

Color brownish above; pale below; sides with yellowish and brown stripes, the upper ones often more or less wavy; top of head vermiculate; shoulder girdle with a large black blotch at upper anterior angle of opercle; a dark band from eyes across lower jaw; fins mostly plain; the dorsal with more or less distinct spots at base.

This widely distributed species was not taken by us. The above description is based on specimens from Massachusetts, Florida, Cuba, Hawaiian Islands, Japan and Philippine Islands.

Widely distributed throughout the tropical seas.

Order XI. Synentognathi.

Family XXX. **Belonidæ.**

The Needlefishes.

Body very elongate, slender, compressed or not; both jaws produced into a beak, the lower one the longer; maxillary united to the premaxillaries; each jaw provided with a band of small, short, pointed

teeth, and a series of enlarged rather wide set teeth; scales small; lateral line low, running as a fold along side of belly; dorsal fin opposite the anal, both rather long; no finlets. Air bladder present.

KEY TO THE GENERA.

a. Body moderately compressed; the depth not greatly exceeding width. *Tylosurus,* p. 224.

aa. Body very strongly compressed, more or less ribbon-shaped, the depth more than twice the width. *Ablennes,* p. 231.

64. Genus **Tylosurus** Cocco.

Tylosurus Cocco, Giorn. Sci. Lett. Arti Sicilia, XLII, 1833, No. 124 (type *Tylosurus cantraini* Cocco=*Esox imperialis* Rafinesque).

Body very elongate, not much compressed; dorsal and anal elevated anteriorly, falcate; gill-rakers obsolete. Other characters included in family description.

KEY TO THE SPECIES.

a. Ventral fins well developed, nearly or quite as long as the pectorals; dorsal fin slightly longer than the anal, with 19 to 24 rays.

b. Jaws very strong, not fragile, and rather shorter than in related species; snout 1.6 to 1.7 in head; enlarged series of teeth in jaws very strong, notably compressed, with sharp cutting edges. *fodiator,* p. 225.

bb. Jaws more slender, fragile, and rather longer; snout 1.4 to 1.6 in head; enlarged teeth in jaws notably weaker, little if at all compressed.

c. Enlarged series of teeth moderate, little compressed, with sharp cutting edges; opercles with scales on anterior margin; dorsal fin inserted directly over origin of anal. *raphidoma,* p. 226.

cc. Enlarged series of teeth slender and very pointed, not compressed; opercles entirely naked; dorsal fins inserted slightly behind origin of anal. *pacificus,* p. 227.

aa. Ventral fins small, never much more than half the length of pectorals; dorsal fin slightly shorter than the anal, with 14 to 16 rays.

d. The strongly depressed caudal peduncle with a prominent keel in lateral line; snout very long and slender, 1.2 to 1.4 in head. *stolzmanni,* p. 228.

dd. Caudal peduncle very little, if at all, depressed, without an evident keel; snout shorter, 1.43 to 1.55 in head.

e. Opercles almost completely covered with scales; dorsal with 15 or 16 rays; ventral fins moderate, a little more than half the length of pectorals; no black spot above base of pectorals. *tinucu*, p. 229.

ee. Opercles with the lower half mostly naked; dorsal fin with 14 rays; ventral fins very short, scarcely more than a third the length of pectorals; an evident black spot above base of pectorals. *scapularis*, p. 230.

162. Tylosurus fodiator Jordan & Gilbert.

Tylosurus fodiator Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 459 (Mazatlan); Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 353; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 715; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 52.

Head 3.25 to 3.5; depth 14.7 to 25, or 4.5 to 7.7 in head; D. 19 to 22; A. 16 to 20.

Body very elongate, nearly cylindrical, as wide as deep; head depressed above, more or less quadrate, the middle of upper surface with a broad, shallow, longitudinal groove, the surface striate at sides, forming a prominent ridge above the eyes; snout very strong, shorter than in related species, its length 1.55 to 1.65 in head; eye 8.6 to 11.5; interorbital space rather broad, 1.55 to 1.85 in postorbital part of head; the enlarged teeth in the jaws strong, compressed, with sharp cutting edges; scales very small, about 450 in a lateral series; cheeks fully scaled; opercles and top of head nearly or entirely naked; lateral line posteriorly with a low dermal keel; dorsal fin inserted over or slightly in advance of anal, the anterior rays elevated in adult, nearly as long as pectorals, the posterior rays very short; in the young the posterior rays are higher than the anterior ones; caudal lunate, the lower lobe the longer; anal similar to dorsal, but the posterior rays not produced in young; ventral fins well developed, only slightly shorter than pectorals, inserted about midway between middle of eye and base of caudal; pectorals moderate, 3.6 to 4.4 in head.

Color of adult greenish above; silvery below; middle line of back somewhat darker; anal fin pale; all other fins with more or less dusky; young dark green above; black below; posterior rays of dorsal and base of caudal black; fins otherwise mostly pale.

Of this species there are 56 small specimens, ranging from 30 to 115 mm. in length, in the present collection. The above description

is based on these and 2 type specimens, 985 and 880 mm. in length, from Mazatlan. It is readily distinguished from other species of this genus by the strong jaws.

Known from Mazatlan south to Panama. Our specimens are from Chame Point and Taboga Islands.

163. Tylosurus raphidoma (Ranzani).

Belone raphidoma Ranzani, Novi Comment. Ac. Sci. Inst. Bonon., V, 1842, 359, Pl. XXXVII, fig. 1 (Brazil); Günther, Cat. Fish. Brit. Mus., VI, 1866, 249.

Belone gerania Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 1846, 437 (Martinique); Günther, Cat. Fish. Brit. Mus., VI, 1866, 241.

Belone crassa Poey, Memorias, II, 1861, 291 (Cuba).

Belone melanochira Poey, Memorias, II, 1861, 294 (Havana).

Tylosurus gladius Bean, Proc. U. S. Nat. Mus., 1882, 430 (Pensacola, Fla.); Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 901.

Tylosurus crassus Jordan, Proc. U. S. Nat. Mus., 1884, 112.

Tylosurus raphidoma Jordan, Proc. U. S. Nat. Mus., 1886, 35; Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 353; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 715, Pl. CXVI, fig. 308.

Head 2.9 to 3.35; depth 13.3 to 18, or 4.35 to 5.8 in head; D. 22 to 24; A. 20 to 22.

Body elongate, slender, slightly compressed, becoming more robust with age; head flat above, somewhat quadrate, a little deeper than wide, middle of upper surface with a very shallow groove, the sides weakly striate, forming a low ridge over eyes; snout of moderate length, rather strong, but tapering rapidly, its length 1.4 to 1.6 in head; eye 8.0 to 9.1; interorbital space rather wide, 1.4 to 1.64 in postorbital part of head; teeth in the jaws moderate, the enlarged series slightly compressed, with sharp cutting edges; scales very small, about 350 in a lateral series; cheeks fully scaled; opercle with scales on anterior margin only; upper surface of head with few scattered scales; lateral line forming a low dermal keel on caudal peduncle; dorsal fin inserted directly over the origin of the anal, elevated anteriorly, the longest ray not much shorter than pectorals, the posterior rays short in adult, but long in the young; caudal fin deeply concave, the lower lobe much the longer; anal similar to dorsal; ventral fins large, as long as the pectorals, inserted about midway between anterior margin of eyes and

base of caudal; pectorals rather long, slightly longer than postorbital part of head, 3.46 to 4.15 in length of head.

Color dark green above, sides and below silvery; middle of back with a darker band, with a narrow black line on each side; sides with an indistinct, dark, silvery band; dermal keel on caudal peduncle black; fins all with more or less dusky; the dorsal fin usually mostly black; distal third of pectorals black.

Of this species there are 21 specimens, ranging from 245 to 485 mm. in length, in the present collection.

Known from North Carolina south to Brazil. Our specimens are from Mindi Cut; Colon Reef; Fox Bay, Colon; Colon market, and Porto Bello.

164. Tylosurus pacificus (Steindachner).

Belone pacifica Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., III, 1875, 65 (Panama; Acapulco).

Tylosurus pacificus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 624; Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 355; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 716; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 52 (Panama Bay).

Head 3.4; depth 12.7, or 3.8 in head; D. 23; A. 21.

Body very elongate, nearly cylindrical, almost as wide as deep, heaviest in front of ventrals, from thence tapering in both directions; head rather low, more or less quadrate, the middle of upper surface with a rather narrow but prominent groove; striate at sides, the ridge over eyes not very prominent; snout slender, its length 1.55 in head; eye 9.3; interorbital space of moderate width, 1.85 in postorbital part of head; teeth in the jaws very weak, small and pointed; scales very small, about 400 in a lateral series; cheeks scaly; opercles and upper surface of head naked; lateral line forming a slight keel posteriorly; dorsal fin inserted slightly behind the origin of the anal, the anterior rays moderately elevated, nearly as long as the pectorals, the posterior rays very short; caudal fin deeply lunate, the lower lobe the longer; anal similar to dorsal; ventral fins only slightly shorter than pectorals, inserted about midway between base of caudal and middle of eye; pectorals moderate, 3.9 in head.

Color in alcohol dark brown above; sides and below silvery; median line of back slightly darker; a slight trace of a lateral band anteriorly; dermal keel on caudal peduncle black; anal fin mostly pale; all the other fins with more or less dusky.

Of this species we have but a single specimen, 665 mm. in length. It is distinguished from related species by the very small teeth.

Known from Acapulco to Panama. Our specimen was purchased in the Panama City market.

165. Tylosurus stolzmanni (Steindachner).

Belone stolzmanni Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXVIII) Ichth. Beitr., VII, 1878, 21 (Tumbez, Peru).

Tylosurus sierrita Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 458 (Mazatlan).

Tylosurus stolzmanni Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 349; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 713; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 52 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 84.

Head 2.65 to 3.0; depth 22 to 25, or 7.7 to 8.6 in head; D. 14 or 15; A. 17 to 19.

Body slender, very slightly compressed; head flat above, more or less quadrate, the middle of the upper surface with a rather prominent longitudinal groove, becoming very broad and shallow in front of eyes, striate laterally, forming a rather prominent ridge above eyes; snout very long and slender, usually broken in preserved specimens, its length 1.2 to 1.4 in head; eye 12.7 to 14.8; interorbital space rather narrow, 2.4 to 3.3 in postorbital part of head; teeth in the jaws moderate, the enlarged ones little, if at all, compressed, very sharply pointed; scales small, about 325 in a lateral series; cheeks fully scaled, also the upper two-thirds of opercles; the groove in upper surface of head scaly, the rest of upper surface mostly naked; lateral line forming a rather prominent dermal keel on the depressed caudal peduncle; dorsal fin inserted notably behind origin of anal, elevated anteriorly, but the longest rays shorter than pectorals, the posterior rays very low; caudal fin concave, the lower lobe the longer; anal fin similar to dorsal in shape, but larger; ventral fins rather short, only a little more than half the length of pectorals, usually inserted slightly nearer base of caudal than posterior margin of eye, sometimes midway between margin of preopercle and base of caudal; pectoral fins rather long, as long as postorbital part of head, 5.5 to 6.6 in head.

Color dark green above, sides and below pale silvery; a dark band on median line of back with a narrow dark line on each side, these most distinct in young; a dark lateral band extends from upper angle of

gill-opening to base of caudal; ventral fins pale; other fins with more or less dusky; distal half of pectorals black.

Of this species there are only 4 specimens, ranging from 50 to 400 mm. in length, in the present collection. We also examined a large specimen, 700 mm. in length, from Wreck Bay, Chatam Island.

Ranging from Guaymas south to Peru. Our specimens are from Chame Point and Taboga Island.

166. Tylosurus timucu (Walbaum).

Esox timucu Walbaum, Artedi Piscium, III, 1792, 88 (Brazil).

Belone subtruncata Poey, Memorias, II, 1861, 295 (Havana).

Belone depressa Poey, Memorias, II, 1861, 296 (Havana).

Tylosurus sagitta Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 25 (Key West).

Tylosurus subtruncatus Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 346.

Tylosurus timucu Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 711.

Head 2.5 to 3.1; depth 15.5 to 20, or 5.0 to 7.9 in head; D. 15 or 16; A. 16 to 18.

Body very elongate, slender, nearly as wide as deep, becoming more robust with age; head flat above, considerably deeper than wide, the middle of upper surface with a rather deep groove, rising to level of head about an orbit's diameter back of eyes, the side striate, with a rather prominent ridge over eyes to upper angle of gill-opening; snout very long and slender, its length 1.45 to 1.55; eye 10.5 to 13.4; interorbital space rather narrow, 2.35 to 2.75 in postorbital part of head; teeth in the jaws rather small, the enlarged series not compressed, very sharply pointed; scales small, about 225 in a lateral series; cheeks and opercles completely scaled; groove in upper surface of head scaly, the rest of the surface mostly naked; lateral line forming a slight keel on caudal peduncle in adult, not evident in young; dorsal fin inserted a little behind origin of anal, elevated anteriorly, the longest rays only slightly shorter than pectorals, the posterior rays apparently not produced in young; caudal fin moderately concave, the lower lobe the larger; anal similar to the dorsal, but slightly larger; ventral fins small, only a little more than half the length of pectorals, inserted a little nearer margin of preopercle than base of caudal; pectoral fins rather long, a little longer than postorbital part of head, 3.95 to 4.8 in length of head.

Color dull greenish above; pale silvery below; middle of back with a dark band with a narrow black line at each side; sides with a dark silvery band, this most conspicuous in young; no black blotch above base of pectorals; fins mostly pale in young, sometimes with only a dusky margin on dorsal and caudal, more dusky in adult; the distal portion of pectorals black.

There are 17 specimens of this species, ranging from 155 to 525 mm. in length, in the present collection.

Ranging from Florida to Brazil. Our specimens are from Fox Bay, Colon; Colon market; and Porto Bello.

167. Tylosurus scapularis Jordan & Gilbert.

Tylosurus scapularis Jordan & Gilbert, Bull. U. S. Fish. Comm., I, 1881 (1882), 307 (Panama); Jordan, Proc. U. S. Nat. Mus., 1885, 370; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 711; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 51 (Miraflores); Starks, Proc. U. S. Nat. Mus., 1906, 782, fig. 7.

Tylosurus subtruncatus (misprint for *T. scapularis*) Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 346.

Head 2.7 to 2.87; depth 14.5 to 23, or 5.5 to 8.4 in head; D. 14; A. 15 to 17.

Body long and slender, becoming more robust with age, quite as wide as deep; head depressed above, a little deeper than wide, the middle of upper surface with a deep groove rising to the level of head a short distance back of eyes; a prominent ridge from eye to upper angle of opercle; snout long and slender, its length 1.43 to 1.53; eye 12.4 to 13.7; interorbital space rather narrow, 2.75 to 3.05 in postorbital part of head; teeth in the jaws moderate, the enlarged series little, if at all, compressed, very sharply pointed; scales small, about 275 in a lateral series; cheeks fully scaled; opercles nearly or entirely naked on lower half; grooved portions of upper surface of head covered with scales, the rest of the surface naked; lateral line not forming a keel on caudal peduncle; dorsal fin inserted a short distance behind the origin of the anal, the anterior rays not greatly elevated, shorter than the pectorals; caudal fin only slightly concave, the lower lobe notably longer; anal similar to dorsal in form, but larger, the rays longer; ventral fins very small, only slightly more than a third the length of pectorals, inserted a little nearer base of caudal than posterior margin of eyes; pectorals rather small, shorter than postorbital part of head, 4.0 to 4.75 in head.

Color greenish brown above, sides and below with numerous brown

dots; middle of back with 3 parallel dark lines; sides with a silvery band, rather indistinct in largest specimens; an evident black spot above base of pectorals; pectoral and ventral fins usually pale, occasionally with a few dusky points; other fins all more or less dusky.

Of this species there are 14 specimens, ranging from 160 to 390 mm. in length, in the present collection.

Known only from Panama. Our specimens are from tide streams, Balboa; and Panama Bay, Balboa. Common in the tide streams about Balboa, but difficult to catch, as it usually manages, either to go through, or over, the net.

65. Genus **Ablennes** Jordan & Fordice.

Athlennes Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 342 (type *Belone hians* Cuvier & Valenciennes).

Ablennes Int. Comm. Zoöl. Nomenc., Smiths. Pub. 2060, 1912, Opinion 41, 94 (Revised spelling).

This genus differs from *Tylosurus* principally in the greatly compressed body.

168. Ablennes hians (Cuvier & Valenciennes).

Belone hians Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 1846, 432, Pl. DXLVIII (Havana; Bahia).

Belone maculata Poey, Memorias, II, 1861, 290 (Havana).

Tylosurus hians Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 373 & 901.

Athlennes hians Jordan & Fordice, Proc. U. S. Nat. Mus., 1886, 342; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 718.

Head 2.9 to 3.6; depth 13 to 19.7; D. 23 to 25; A. 25 to 27.

Body very strongly compressed, the width notably less than half the depth; head compressed, flat above, much deeper than wide, middle of upper surface with a broad, shallow, longitudinal groove; snout long, slender, very fragile, its length 1.32 to 1.54 in head; eye 8.8 to 12.3; interorbital space moderate, 1.9 to 2.5 in postorbital part of head; teeth in the jaws rather small, the enlarged series round and sharply pointed; scales very small, about 420 in a lateral series; cheeks with a patch of scales; opercles naked; upper surface of head naked, except for a few scales in anterior portion of the shallow depression; lateral line running very low, on edge of abdomen, without evident dermal keel on caudal peduncle; dorsal fin inserted a little behind the origin

of the anal, notably elevated anteriorly in adult, little elevated in young, but with the posterior rays notably produced, much longer than the anterior ones; caudal fin deeply concave, the lower lobe slightly the larger; anal fin similar to the dorsal, but with the posterior rays short at all ages; ventral fins moderate, inserted a little nearer the anterior margin of eye than the base of caudal; pectorals proportionately much longer in adult than in young, as long as postorbital part of head in young, nearly twice the length of postorbital part of head in large specimens, 2.5 to 5.5 in head.

Color in life grassy green above; sides and below clear silvery; snout dark green, its bones the color of old brass; about 15 black bars on sides, these most distinct in young; dorsal fin anteriorly green in young, becoming wholly black with age; caudal fin mostly green in young, largely black in adult; other fins all pale in young, partly or wholly black in adult.

This species was not taken on the coast of Panama by us, but it is here included because it comes within the range of the present work. The above description is based on specimens from Beaufort, North Carolina, ranging in length from 160 to 755 mm.

Known from Massachusetts south to Brazil; also recorded from Cape Verde Islands.

Family XXXI. Hemirhamphidæ.

Body elongate, more or less compressed; upper jaw short; lower jaw various, sometimes much produced, the produced portion sometimes equal to or longer than the rest of head; teeth short, usually tricuspid, in more or less definite bands in each jaw, fitting against each other; gill-rakers long or short; scales rather large, cycloid, usually more or less deciduous; anal fin modified in the viviparous species, unmodified in the others, and usually similar to the dorsal; no finlets; caudal fin rounded or forked, if forked the lower lobe the larger. "Third upper pharyngeal on each side much enlarged, solidly united with its fellow to form an oval plate, with slightly convex surface and covered with blunt tricuspid teeth; this is about as large as the united lower pharyngeals and fits into the cavity of the latter; fourth upper pharyngeal wanting or grown fast to the third; lower pharyngeal large, thick, triangular, with concave surface. Vertebræ about 50. (Characters verified in *Hemirhamphus browni, Hyporhamphus roberti* and *Chriodorus atherinoides*)." (Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, p. 718.)

KEY TO THE GENERA.

a. Lower jaw much produced, beak-like, usually about as long as rest of head.

b. Air bladder divided into compartments, cellular; sides of body vertical; dorsal fin inserted in advance of anal and slightly longer, its last ray a little produced; ventral fins inserted far backward, very much nearer base of caudal than gill-opening. *Hemirhamphus,* p. 233.

bb. Air bladder simple; sides of body not quite vertical, more or less convex; dorsal and anal opposite each other, the former slightly shorter than the latter, its last ray not produced; ventral fins inserted well forward, usually at a point about midway between base of caudal and gill-opening. *Hyporhamphus,* p. 236.

66. Genus **Hemirhamphus** Cuvier.

Hemir-Hamphus Cuvier, Règne Animal, Ed. I, II, 1817, 186 (type *Esox brasiliensis* Linnæus).

Body rather robust; the sides vertical and parallel; head low, depressed above; lower jaw much produced, usually longer than rest of head; air bladder divided into many compartments, cellular; dorsal fin a little longer than the anal, its insertion in advance of that of the anal, the last ray a little produced; ventral fins small, and inserted far backward, very much nearer the base of caudal than gill-opening; the distance from tip of upper jaw to origin of ventrals usually nearly twice the distance from their origin to base of caudal.

KEY TO THE SPECIES.

a. Pectoral fins of moderate length, 5.9 to 6.8 in length of body measured from tip of upper jaw to base of caudal; ventral fins inserted at a point half as far from base of caudal as from tip of upper jaw; gill-rakers short, 21 to 24 on lower limb of first arch; scales 53 to 57. *brasiliensis,* p. 234.

aa. Pectorals fins long, 4.85 to 5.5 in length of body; ventral fins more anteriorly placed, inserted at a point more than half as far from base of caudal as from tip of upper jaw; gill-rakers longer, 26 to 27 on lower limb of first arch; scales 56 to 61. *saltator,* p. 235.

169. Hemirhamphus brasiliensis (Linnæus).

Esox brasiliensis Linnæus, Syst. Nat., Ed. X, 1758, 314 (Jamaica).

Hemirhamphus marginatus Le Sueur, Journ. Ac. Nat. Sci. Phila., II, 1821, 135 (Lesser Antilles; not of Forskål).

Hemirhamphus brownii Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 13 (Guadaloupe; Martinique).

Hemirhamphus pleii Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 21 (Martinique; San Domingo).

Macrognathus brevirostris Gronow, Cat. Fish, 1854, 148 (Jamaica; after Browne).

Hemirhamphus filamentosus Poey, Memorias, II, 1861, 297 (Cuba).

Hemirhamphus pleii Günther, Cat. Fish. Brit. Mus., VI, 1866, 269; Meek & Goss, Proc. Ac. Nat. Sci. Phila., 1884, 224.

Hemirhamphus brasiliensis Günther, Cat. Fish. Brit. Mus., VI, 1866, 270; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 902; Jordan & Evermann (in part), Bull. U. S. Nat. Mus., XLVII, 1896, 722; Evermann & Marsh, Bull. U. S. Fish Comm., XX, Pt. I, 1900 (1902), 102, fig. 19.

Head* 4.35 to 4.63; depth 5.45 to 6.35; D. 13 or 14; A. 11 to 13; scales 53 to 57.

Body elongate, compressed, the sides vertical; dorsal and ventral outlines about evenly curved; head rather low; the mandible much produced, from tip of upper jaw 3.3 to 3.96 in length of body; length of snout 2.8 to 3.5 in head; eye 3.65 to 4.15; interorbital space flat, slightly broader than eye; teeth in the jaws short, mostly in 3 series; gill-rakers short, scarcely as long as pupil, 21 to 24 including rudiments on lower limb of first arch; scales thin, transparent, almost wholly without pigment; dorsal fin inserted posteriorly, slightly in advance of vent, the last ray slightly produced; caudal forked, the lower lobe much the larger; anal rather small, inserted under middle of base of dorsal; ventrals rather small, inserted posteriorly, from their insertion to base of caudal equaling half the distance from that point to tip of upper jaw; pectorals moderate, 5.9 to 6.8 in length of body.

Color dusky brown above; sides and below bright silvery; median line of back with an indistinct dark streak, with a black line on each side; an inconspicuous dark streak extending from upper angle of gill-opening to base of caudal; dorsal, caudal and pectorals with more or less dusky, other fins pale.

*Head and length of body are measured from tip of upper jaw.

Of this species 4 specimens, ranging from 300 to 380 mm. in length, were preserved.

Known from Key West, Florida, south to Bahia, Brazil. Also recorded from Angola, West Africa. Our specimens are from the Colon market.

170. Hemirhamphus saltator Gilbert & Starks.

Hemirhamphus balao Jordan, Proc. U. S. Nat. Mus., 1885, 370 (not of Le Sueur).

Hemirhamphus brasiliensis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 722 (in part).

Hemirhamphus saltator Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 53, Pl. IX, fig. 16 (Panama Bay); Snodgrass and Heller, Wash. Ac. Sci., VI, 1905, 350; Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 85.

Head 4.2 to 5.15; depth 5.85 to 6.7; D. 13 or 14; A. 11 or 12; scales 56 to 61.

Body elongate, compressed, the sides vertical; dorsal and ventral outlines about evenly curved; head low; the mandible much produced, from tip of upper jaw 3.2 to 4.15 in length of body; snout 2.5 to 3.2 in head; eye 3.5 to 4.2; interorbital space flat, slightly broader than eye; teeth in the jaws short, mostly in two series; gill-rakers of moderate length, slightly longer than pupil, 26 or 27 including rudiments on lower limb of first arch; scales thin, transparent, almost wholly without pigment; dorsal fin inserted posteriorly, slightly in advance of vent, the last ray slightly produced; caudal forked, the lower lobe much the larger; anal rather small, inserted under middle of base of dorsal; ventrals inserted posteriorly, from their insertion to base of caudal slightly more than half the distance from that point to tip of upper jaw; pectorals long, 4.85 to 5.5 in length of body.

Color dusky brown above; sides and below bright silvery; median line of back with an indistinct dark streak, with a black line on each side; an inconspicuous dark lateral streak extending from upper angle of gill-opening to base of caudal; anal fin pale; all the fins with more or less dusky; dorsal and caudal sometimes quite black; the young darker, with an evident black lateral band extending from snout through lower margin of eye to base of caudal, this band later breaking up into spots and disappearing with age.

Of this species 30 specimens, ranging from 30 to 440 mm. in length, were preserved. It is closely allied to *H. brasiliensis,* from which it may be distinguished by the longer pectoral fins, the longer and more

numerous gill-rakers, and the more anterior position of the ventral fins. There are a few more scales in a lateral series, and the average number of dorsal and anal rays is slightly smaller. Specimens taken early in February are well distended with roe.

Known from Acapulco south to the Galapagos Islands. Our specimens are from Chame Point, Taboga Island, Balboa, and Panama market.

67. Genus **Hyporhamphus** Gill.

Hyporhamphus Gill, Proc. Ac. Nat. Sci. Phila., 1859, 131, (type *Hyporhamphus tricuspidatus* Gill=*Hemirhamphus unifasciatus* Ranzani).

Body elongate, moderately compressed, the sides scarcely vertical, usually more or less convex; head rather low, depressed above; lower jaw much produced, never much shorter, and often longer than rest of head, proportionately longer in young than in adult; air bladder simple, not divided into compartments; dorsal and anal similar, opposite each other, the dorsal slightly shorter than the anal, its last ray not produced; ventral fins well forward, usually inserted at a point about midway between base of caudal and gill-opening; sides with a plumbeous band.

KEY TO THE SPECIES.

a. Gill-rakers short, in moderate numbers, 20 to 25 on lower limb of first arch; ventral fins usually inserted at a point slightly nearer base of caudal than posterior margin of eye. *unifasciatus*, p. 237.

aa. Gill-rakers longer and more numerous, 28 or more on lower limb of first arch.

b. Mandible much longer than rest of head, its length from tip of upper jaw 2.7 to 3.7 in length of body; gill-rakers 28 to 31; ventral fins inserted slightly nearer posterior margin of opercle than base of caudal. *roberti*, p. 239.

bb. Mandible shorter, slightly longer than rest of head in young, but shorter in adult, 3.5 to 5.9 in length of body; gill-rakers 34 to 39.

c. Body rather deep, its depth 7.4 to 8.5 in its length; scales quite persistent; dorsal and anal scaly; ventral fins inserted nearer anterior margin of eye than base of caudal; back densely punctulate with brown, the dots more or less confluent at edges of scales. *gilli* sp. nov., p. 240.

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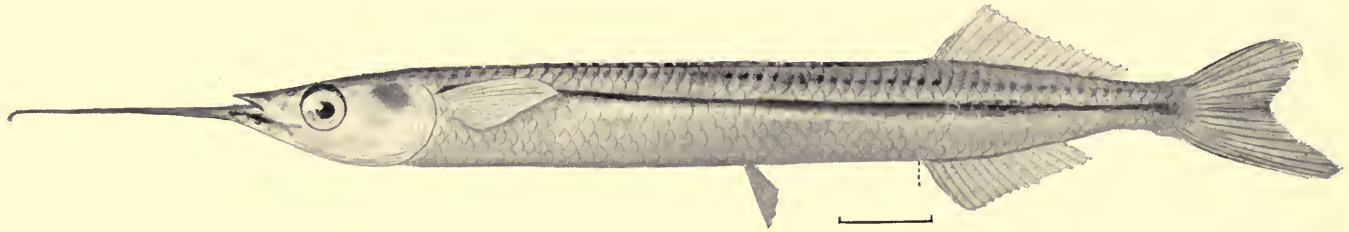

FIG. 1. HYPORHAMPHUS UNIFASCIATUS (Ranzani).
Drawn from U. S. N. M. No. 79668.

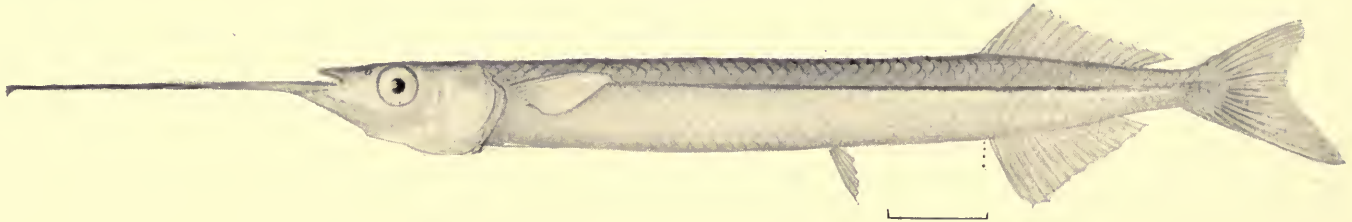

FIG. 2. HYPORHAMPHUS ROBERTI (Cuvier & Valenciennes).
Drawn from U. S. N. M. No. 79662.

cc. Body slender, its depth 8.2 to 10.3 in its length; scales deciduous, few or none remaining on preserved specimens; dorsal and anal apparently naked; ventral fins inserted nearer base of caudal than anterior margin of eye; color paler, the back with fewer brown dots. *snyderi* sp. nov., p. 240.

171. Hyporhamphus unifasciatus (Ranzani). (Plate XVI, fig. 1.)

Hemirhamphus unifasciatus Ranzani, Novi Comment. Ac. Sci. Inst. Bonon., V, 1842, 326 (Brazil); Günther, Cat. Fish. Brit. Mus., VI, 1866, 262; Jordan & Gilbert, Bull. U. S. Fish Comm., II, 1882 (1883), 106; Meek & Goss, Proc. Ac. Nat. Sci. Phila., 1884, 222.

Hemirhamphus richardi Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 26 (Antilles; Cayenne; Bahia; Rio de Janeiro).

Hyporhamphus tricuspidatus Gill, Proc. Ac. Nat. Sci. Phila., 1859, 131 (Barbadoes).

Hemirhamphus fasciatus Poey, Memorias, II, 1861, 299 (Cuba; not of Bleeker).

Hemirhamphus poeyi Günther, Cat. Fish. Brit. Mus., VI, 1866, 262 (after *H. fasciatus* Poey); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 373 and 381.

Hemirhamphus roberti Günther, Cat. Fish. Brit. Mus., VI, 1866, 263 (not of Cuvier & Valenciennes); Meek & Goss, Proc. Ac. Nat. Sci. Phila., 1884, 223.

?Hemirhamphus unifasciatus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274.

Hyporhamphus unifasciatus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 720, Pl. CXVI, fig. 311.

?Hyporhamphus roberti Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 721, Pl. CXVII, fig. 312.

Hyporhamphus roberti Kendall and Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 84.

Head 4.4 to 5.0; depth 6.3 to 9.8; D. 13 to 16; A. 15 to 17; scales 52 to 59.

Body elongate, compressed, becoming proportionately much deeper with age; head rather low, depressed above; the mandible moderately produced, variable in length, but always proportionately longer in young than in adult, slightly longer than rest of head in young, but notably shorter in adult, its length from tip of upper jaw 3.6 to 5.85 in length of body; snout 2.5 to 3.1 in head; eye 3.6 to 4.4; interorbital space broader than eye; teeth in the jaws short, in bands; gill-rakers short and rather blunt, 20 to 25 on the lower limb of first arch; scales

thin, apparently more firm than in other species; dorsal and anal similar, placed posteriorly, each densely scaled, at least at base; caudal forked, the lower lobe much the larger; ventrals small, usually inserted slightly nearer base of caudal than posterior margin of eye; pectorals short, 1.4 to 1.85 in head.

Color mostly silvery; back with brown or dusky punctulations, these most numerous and often more or less confluent at margin of scales; middle of back with 3 narrow black lines; sides with a plumbeous band, margined above with black; upper surface of head and mandible mostly black, the latter with a red tip in life; caudal and the tips of the longest rays of dorsal and anal black or dusky, fins otherwise mostly pale.

We have 53 specimens of this species, ranging from 160 to 230 mm. in length, from the Atlantic and 20, ranging from 90 to 290 mm. in length, from the Pacific.

We are unable to find any tangible difference upon which to separate the Atlantic coast representatives from those of the Pacific. Certain small differences, however, seem to exist, but these in every case overlap. In 10 Atlantic specimens the gill-rakers range from 20 to 24, with an average number of 21.1; in an equal number of Pacific coast specimens they range from 22 to 25, with an average number of 23.3. Comparing in each case the same groups of specimens as above, we have in the Atlantic group for the number of dorsal rays, 14 to 16, with an average of 15.2, and for the anal 15 to 17, with an average of 16.1; for the dorsal rays in the Pacific group we also have 14 to 16, but with an average of 14.2, for the anal 15 to 17 with an average of 15.7. In comparing specimens of like size, it also seems as if the Pacific coast representatives are a little more slender.

An examination of the material of this genus in the National Museum indicates that all specimens from the West Indies and our Atlantic coast may be referred to the present species. There is considerable variation with age and among individuals with respect to depth of body and length of mandible. In the numerous specimens examined from the above named regions, these characters seem to intergrade perfectly. This fish often runs in very large schools. One day while seining a school of them was encountered, and each seine haul yielded them in great numbers. While large ones are sometimes brought to market, they do not seem to be highly valued as food by the Canal Zone inhabitants.

The range of this species on the Atlantic coast extends from Rhode Island south to Brazil. The range on the Pacific coast seems to ex-

tend from the Gulf of California south to the Galapagos Islands. Our Atlantic coast specimens are from Fox Bay, Colon; and Colon market. Pacific coast specimens are from Chame Point; Panama Bay, Balboa; and Panama market.

172. Hyporhamphus roberti (Cuvier & Valenciennes). (Plate XVI, fig. 2.)

Hemirhamphus roberti Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 24 (Cayenne).

Head 4.6 to 5.0; depth 9.7 to 10.5; D. 14 to 16; A. 15 to 17; scales 52 to 56.

Body very elongate, slender, little compressed; head low, depressed above; the mandible very much produced, much longer than rest of head, from tip of upper jaw 2.7 to 3.17 in length of body; snout 2.7 to 3.0 in head; eye 3.55 to 4; interorbital space broader than eye; teeth in the jaws very short, in bands; gill-rakers very slender, rather close set, 28 to 31 on lower limb of first arch; scales thin, more or less deciduous; dorsal and anal similar, placed posteriorly, with few or no scales; caudal forked, the lower lobe much the larger; ventrals small, inserted slightly nearer posterior margin of opercle than base of caudal; pectorals short, 1.75 to 2.0 in head.

Color mostly silvery; upper portion of body with brown punctulations; back with 3 narrow black lines; sides with a plumbeous band, margined above with black; upper surface of head and mandible mostly black, the latter with a red tip in life; fins mostly pale, usually with some dusky points.

Of this species 14 specimens, ranging from 70 to 160 mm. in total length, were secured.

An examination of the material of this genus from the West Indies and our Atlantic coast, contained in the National Museum collections, has failed to reveal a single specimen of this species. We believe that all this material can be referred to a single species, *H. unifasciatus,* and that our specimens are representative of the true *H. roberti* of Cuvier and Valenciennes. This species differs notably from *H. unifasciatus* in the more numerous gill-rakers, in the very slender body, longer mandible, and in the more posterior insertion of the ventral fins.

The known range of this species then extends from Panama south to French Guiana. Our specimens are from Toro Point, and Fox Bay, Colon.

173. Hyporhamphus gilli sp. nov. (Plate XVII, fig. 1.)

Hemirhamphus roberti Gilbert, Proc. U. S. Nat. Mus., 1890, 450 (in part; one specimen from Chatham Id.).

Hyporhamphus unifasciatus Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 84 (not of Ranzani).

Type No. 81736, U. S. N. M.; length 170 mm.; Panama Bay, Balboa.

Head 4.5 to 4.9; depth 7.4 to 8.5; D. 14 or 15; A. 15 or 16; scales 54 to 58.

Body elongate, compressed; head low, depressed above; mandible moderately produced, equal to or shorter than rest of head, from tip of upper jaw 4.45 to 5.9 in length; interorbital space flat, broader than eye; teeth in the jaws very short, in narrow bands; gill-rakers very slender, close set, 34 to 38 on lower limb of first arch; scales thin, moderately adherent; dorsal and anal similar, each covered with small scales, at least at base; caudal forked, the lower lobe much the larger; ventrals small, inserted slightly nearer anterior margin of eye than base of caudal; pectorals short, 1.73 to 1.92 in head.

Color mostly silvery; back with brown punctulations, these often more or less confluent along edges of scales; middle of back with 3 narrow black lines; sides with a plumbeous band margined above with black; snout and mandible black, the latter with a red tip in life; caudal and margin of dorsal and anal dusky; fins otherwise mostly pale.

Of this species there are 36 specimens, from 135 to 170 mm. in length, in the present collection. We have also seen specimens from Acapulco, in the National Museum collection, wrongly identified as *H. unifasciatus,* and one specimen from the Galapagos Island (Chatham Id.) wrongly identified as *H. roberti.* In general appearance this species agrees very well with *H. unifasciatus,* but differs from that species in the more numerous gill-rakers, and in the more anterior position of the ventral fins.

This species ranges from Acapulco south to the Galapagos Islands. Our specimens are all from Panama Bay, Balboa.

174. Hyporhamphus snyderi sp. nov. (Plate XVII, fig. 2.)

Hemirhamphus roberti Gilbert, Proc. U. S. Nat. Mus., 1890, 450 (in part; Panama specimens).

?Hyporhamphus roberti Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 53 (Panama Bay).

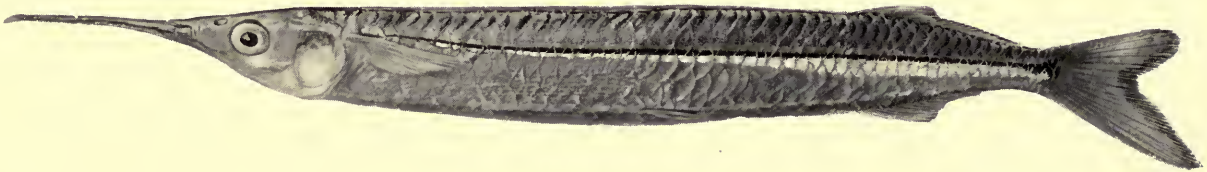

FIG. 1. HYPORHAMPHUS GILLI sp. nov.
From the type 170 mm. in length.

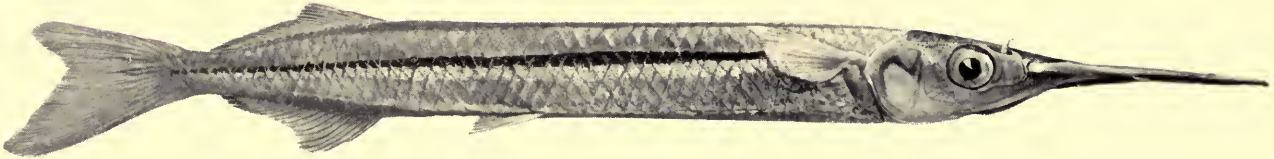

FIG. 2. HYPORHAMPHUS SNYDERI sp. nov.
From the type 175 mm. in length.

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Type No. 81760, U. S. N. M.; length 175 mm.; Panama Bay, Balboa.

Head 4.4 to 5.0; depth 8.2 to 10.3; D. 15 or 16; A. 16 to 18; scales 55 to 60.

Body very elongate, slender, little compressed; head low, depressed above; mandible rather strongly produced, variable, usually slightly longer than head, from tip of upper jaw 3.5 to 4.65 in length of body; snout 2.5 to 2.8 in head; eye 4.0 to 4.85; interorbital space flat, broader than eye; teeth in the jaws short, in bands; gill-rakers very slender, close set, 35 to 39 on lower limb of first arch; scales very thin, deciduous, few remaining on specimens at hand; dorsal and anal similar, apparently without scales; caudal forked, the lower lobe much the larger; ventrals small, inserted slightly nearer base of caudal than posterior margin of eye; pectorals short, 1.65 to 2.0 in head.

Color pale silvery; back with brown punctulations, these most numerous at edges of scales; middle of back with 3 narrow black lines; sides with a plumbeous band, margined with black above; mandible black; caudal and margin of anterior rays of dorsal and anal dusky; fins otherwise pale.

Of this species there are 49 specimens, ranging from 50 to 290 mm. in length, in the present collection. We have also examined 7 specimens taken at Panama and 5 from Concepcion Bay, Lower California. This species differs from *H. gilli* in the more slender body, the more posterior insertion of the ventral fins, the much less persistent scales and in the naked vertical fins. It most resembles *H. rosæ,* a more northern species, known from the coast of California, but differs from it notably in having more gill-rakers and in the more anterior insertion of the ventral fins. *H. rosæ* has only about 25 gill-rakers on the lower limb of the first arch, and its ventral fins are inserted slightly nearer the base of the caudal than the posterior margin of the opercle.

The known range of this species extends from Concepcion Bay, Lower California, south to Panama. Our specimens are from Chame Point; tide streams, Balboa; and Panama Bay, Balboa.

Family XXXII. Exocœtidæ.

The Flying Fishes.

Body elongate; head with more or less vertical sides; mouth terminal, or the lower jaw projecting, the latter not produced into a beak, at least not in the adult; premaxillaries not protractile; maxillary

short, slipping under preorbital; nostrils double, near the eye; teeth various, small and weak; lateral line running low, along edge of belly; scales cycloid, more or less deciduous, extending forward on head; dorsal fin without spines, inserted on posterior part of body; no finlets; caudal fin forked, the lower lobe the longer; anal fin opposite dorsal and more or less similar to it; ventral fins abdominal, sometimes more or less enlarged; pectoral fins inserted high, usually greatly enlarged, used as organs of flight.

Most of the species of this family are widely distributed; they are pelagic, swimming near the surface, and many of them are able to skip or fly through the air for considerable distances. Only 2 species, representatives of 2 genera, occur in the present collection; a few others not represented in this collection are reported from Panama and several others may be expected there. We offer descriptions only for the species taken by us, but we have compiled keys to all of the genera and species which appear to come within the scope of the present work, and under the name of each species we have endeavored to give a reference to the original description and usually also a reference to some general work which appears to give a good description.

KEY TO THE GENERA.

a. Snout long, pointed, the lower jaw strongly projecting, acute; dorsal fin anteriorly notably elevated. *Fodiator*, p. 243.

aa. Snout rather short and blunt, the lower jaw not greatly projecting and not acute.

b. Pectoral fins moderate, not reaching beyond middle of base of dorsal; dorsal fin elevated; the base of anal about equal to base of dorsal. *Parexocœtus*, p. 244.

bb. Pectoral fins very long, usually reaching beyond base of dorsal, nearly or quite to base of caudal.

c. Ventral fins short, not nearly reaching origin of anal, inserted nearer tip of snout than base of caudal; base of anal nearly or quite as long as base of dorsal. *Exocœtus*, p. 244.

cc. Ventral fins long, reaching past middle of base of anal, usually inserted nearer base of caudal than tip of snout.

d. Anal fin long, its base equal to that of dorsal. *Exonautes*, p. 244.

dd. Anal fin short, its base shorter than that of dorsal. *Cypselurus*, p. 245.

68. Genus **Fodiator** Jordan & Meek.

Fodiator Jordan & Meek, Proc. U. S. Nat. Mus., 1885, 45 (type *Exocœtus acutus* Cuvier & Valenciennes).

Body elongate, compressed; head compressed; snout long and pointed; lower jaw acute in adult, protruding prominently, more or less produced into a beak in young; teeth very small; dorsal fin anteriorly elevated; ventral fins moderate; pectoral fins rather moderate, usually about half as long as body.

A single widely distributed species is known, the young of which show a remarkable resemblance to the *Hemirhamphidæ*.

175. **Fodiator acutus** (Cuvier & Valenciennes).

Exocœtus acutus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 125 (Surinam; Nice); Günther, Cat. Fish. Brit. Mus., VI, 1866, 281 (Fernando Po).

Fodiator acutus Jordan & Meek, Proc. U. S. Nat. Mus., 1885, 46; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 728; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 55 (Panama Bay).

Head 3.6 to 4; depth 4.85 to 6; D. 9 or 10; A. 10 or 11; scales about 40.

Body elongate, compressed; head low; snout long, pointed, 2.5 to 3.25 in head; eye moderate, 2.7 to 3.5 in head; interorbital flat, as broad as eye in adult (140 mm.); mouth rather small; the lower jaw strongly projecting, pointed, extending beyond margin of upper jaw a distance equal to length of pupil in adult (140 mm.), much longer in young, beak-like, as in *Hemirhamphus*; maxillary slipping under preorbital; teeth minute, in narrow bands in the jaws; scales large, cycloid; dorsal fin anteriorly notably elevated, the longest rays reaching base of caudal, the posterior rays very short; caudal fin deeply forked, the lower lobe much the longer; anal fin inserted under the origin of dorsal, its anterior rays not notably elevated; ventral fins moderate, only about a third the length of pectoral in adult, about half the pectoral in young (40 mm.), inserted slightly nearer base of caudal than eye, failing to reach origin of anal in adult; pectoral fins rather moderate, reaching to or a little beyond origin of anal, 1.8 to 2.4 in length.

Color of adult bluish black above, silvery below; color rather paler in young; the produced rays of dorsal black, the others pale; caudal fin greenish yellow in adult, pale in young; anal fin pale; ventral fins

pale at base, the distal parts black, at least in young; pectorals mostly black, the upper and lower rays usually pale.

There are 30 specimens, ranging from 15 to 178 mm. in length, at hand. The young are remarkably different from the adult in the development of the lower jaw which in small specimens forms a beak as in *Hemirhamphus*.

Known from both shores of tropical America. Our specimens are all from the Pacific coast, from Chame Point and Balboa.

69. Genus **Parexocœtus** Bleeker.

Parexocœtus Bleeker, Nederl. Tijdsch. Dierk., III, 1866, 126 (type *Exocœtus mento* Cuvier & Valenciennes).

176. Parexocœtus brachypterus (Solander).

Exocœtus brachypterus Solander, in Richardson, Ichthyol. China, in Proc. Brit. Assoc., 1846, 265 (Otaheite).

Parexocœtus brachypterus Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, Pt. I, 1903 (1905), 131, Pl. III.

Range, tropical seas.

70. Genus **Exocœtus** Linnæus.

Exocœtus Linnæus, Syst. Nat., Ed. X, 1758, 316 (type *Exocœtus volitans* Linnæus).

177. Exocœtus volitans Linnæus.

Exocœtus volitans Linnæus, Syst. Nat., Ed. X, 1758, 316 (Locality unknown); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 734.

Range, warm seas; rather common on the Atlantic coast of America.

71. Genus **Exonautes** Jordan & Evermann.

Exonautes Jordan & Evermann, Rept. U. S. Fish Comm., XXI, 1895 (1896), 322 (type *Exocœtus exsiliens* Müller).

KEY TO THE SPECIES.

a. First and second rays of pectorals simple, not divided, the first ray about half as long as the second, the fourth and fifth rays longest; scales in lateral series about 50. *rondeletii*, p. 245.

aa. Second ray of pectoral divided, only the first ray simple, the third and fourth rays longest; scales in lateral series about 58. *rufipinnis*, p. 245.

178. Exonautes rondeletii (Cuvier & Valenciennes).

Exocœtus rondeletii Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 115, Pl. DLXII (Naples, Sicily); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 733.

Range, tropical seas.

179. Exonautes rufipinnis (Cuvier & Valenciennes).

Exocœtus rufipinnis Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 99 (Payta, Peru); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 735.

Range, tropical America; once recorded from the Pacific coast of Panama.

72. Genus **Cypselurus** Swainson.

Cypsilurus Swainson, Nat. Hist. & Class. Fish., II, 1839, 296 (type *Exocœtus nuttalli* Le Sueur=*Exocœtus furcatus* Mitchill).

Body elongate, somewhat compressed; head short, broad; mouth small; jaws about equal; teeth minute or wanting; scales large, deciduous; dorsal fin short; no finlets; anal fin opposite the dorsal, its base shorter than that of dorsal; ventral fins large, posteriorly inserted; pectoral fins very large, reaching past the origin of anal.

KEY TO THE SPECIES.

a. Pectoral fins covered with small, round, dark spots; ventrals usually also with black spots; dorsal rays 11 or 12; anal 8. *callopterus*, p. 246.

aa. Pectoral and ventral fins without small round black spots.

b. Ventral fins inserted equidistant from pupil and base of caudal.

c. Dorsal and anal fins without black markings; ventrals pale; scales about 58; dorsal rays 14; anal 9. *heterurus*, p. 247.

cc. Dorsal fin with one or more dark blotches; anal with a black spot on tips of third to sixth ray; ventrals black with pale margin and a white spot near base; scales about 46; dorsal rays 13; anal 9. *furcatus*, p. 247.

bb. Ventral fins inserted about equidistant from posterior margin of opercle and base of caudal.

d. Pectoral with posterior half black; dorsal with anterior half black; anal white; ventral fins reaching tip of last anal rays; dorsal rays 14; anal 9 or 10. *nigricans*, p. 247.

dd. Pectoral fins uniformly pale; dorsal pale with a round black spot on tips of rays; anal pale; ventral fins not quite reaching base of last anal ray; dorsal rays 12; anal 11. *cyanopterus*, p. 247.

bbb. Ventral fins inserted about equidistant from middle of opercle and base of caudal, reaching middle of base of anal; pectoral fins pale; dorsal with a long black blotch; dorsal rays 13; anal 9 or 10. *bahiensis*, p. 247.

180. Cypselurus callopterus (Günther).

Exocœtus callopterus Günther, Cat. Fish. Brit. Mus., VI, 1866, 292 Panama), and Trans. Zoöl. Soc. Lond., VI, 1868, 479, Pl. LXXXIII; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 740.

Cypselurus callopterus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 55 (Panama).

Head 3.85 to 4.8; depth 5.1 to 5.35; D. 11 or 12; A. 8; scales 46 to 51.

Body elongate, not much compressed, slightly quadrate; head short, rather broad; snout very short, broader than long, 4.1 to 5 in head; eye large, 2.1 to 2.8 in head; interorbital slightly concave, as broad as eye in young (60 mm.), notably broader than eye in adults; mouth small, terminal, the gape mostly transverse; maxillary reaching nostrils, 4.3 to 5 in head; teeth in the jaws in bands, small, more or less distinctly tricuspid; scales large, cycloid, extending forward on head to nostrils; dorsal fin rather small, the anterior and posterior rays slightly elevated; caudal fin deeply forked, the lower lobe notably produced, much longer than the upper; anal fin small, inserted under middle of base of dorsal, its base only slightly more than half as long as base of pectoral; ventral fins long, reaching to the middle of or past the base of anal, about half the length of pectorals in adult, proportionately longer in young; pectoral fins very long, the third and fourth rays longest, reaching to or past tips of ventrals in adult, somewhat shorter in young, 1.25 to 1.65 in length.

Color of adult in alcohol bluish black above, silvery below; the young brownish with dark points, darker below than above, sometimes the abdominal regions are black; dorsal, caudal and anal greenish

with more or less dusky, especially on caudal lobes; ventral fins in adult with the median rays dusky, with black spots, the rest of the fin pale, wholly black or dusky in young with the black spots very faintly visible; pectoral fins greenish, dusky or nearly black in young, with distinct, roundish, black spots.

This fish is represented by 4 large specimens, 240 to 255 mm. in length, and by numerous small ones, 15 to 65 mm. long. The latter were sent by Mr. Robert Tweedlie.

Known only from Panama. The specimens at hand are from Chame Point and the Panama market.

181. Cypselurus heterurus (Rafinesque).

Exocœtus heterurus Rafinesque, Caratteri, etc., 1810, 58 (Palermo); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 735.

Range, Atlantic Ocean, both coasts; common in the warmer regions.

182. Cypselurus furcatus (Mitchill).

Exocœtus furcatus Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 449 (New York); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 737.

Range, warm seas; common on both coasts of the Atlantic Ocean.

183. Cypselurus nigricans (Bennett).

Exocœtus nigricans Bennett, Whaling Voyage, II, 1840, 287 ("Taken in both the Atlantic and Pacific Oceans in lat. 5° N."); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 737.

Range, all tropical seas.

184. Cypselurus cyanopterus (Cuvier & Valenciennes).

Exocœtus cyanopterus Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 1846, 98 (Bahia; Rio de Janeiro); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 739.

Range, coast of Brazil and the Caribbean Sea.

185. Cypselurus bahiensis (Ranzani).

Exocœtus bahiensis Ranzani, Novi Comment. Ac. Sci. Inst. Bonon., V, 1842, 362, Pl. XXXVIII (Bahia); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 739.

Range, tropical seas.

Order XII. Hemibranchii.

Family XXXIII. Fistulariidæ.

The Cornet-fishes.

Body very elongate, much depressed, always broader than deep; head very long, the anterior bones of the skull much produced, forming a long tube, the bones connected by lax membranes, making the tube capable of much expansion; the small mouth situated at the end of the long tube; both jaws and usually the vomer and palatines with small teeth; branchiostegals 5 to 7; gills 4, a slit behind the fourth; gill-membranes separate, free from the isthmus; gill-rakers obsolete; basi-branchial elements wanting; pseudobranchiæ present; scales wanting; bony plates on back, behind skull and on sides and chest, between and behind pectorals; spinous dorsal wanting; soft dorsal posteriorly inserted, somewhat elevated; anal fin similar to and opposite dorsal; caudal fin forked, the middle ray produced into a long filament; ventral fins abdominal, far in advance of dorsal; pectoral fins small, preceded by a smooth area.

73. Genus **Fistularia** Linnæus.

Fistularia Linnæus, Syst. Nat., Ed. X, 1758, 312 (type *Fistularia tabacaria* Linnæus).

Cannorhynchus Cantor, Journ. Roy. Asiat. Soc. Bengal, XVIII, 1849, 211 (type *Fistularia tabacaria* Linnæus, *Fistularia* being regarded as preoccupied by Donati in 1750 for a pre-Linnæan genus of Polyps). Characters of the genus are included in the description of the family.

key to the species.

a. Interorbital (bone) wide, 3.9 to 4.4 in postorbital part of head, with a wide, shallow, and perfectly smooth median furrow; snout short, 1.4 to 1.5 in total length of head; dorsal fin with 17 or 18 rays; anal with 16 or 17; ventral fins inserted a little nearer tip of snout than base of caudal. *corneta*, p. 249.

aa. Interorbital (bone) narrower, the median furrow narrower and deeper, and always slightly roughened by one or more low ridges; snout longer, 1.3 to 1.4 in head; dorsal with 13 to 16 rays; anal with 13 to 15; ventral fins inserted notably nearer base of caudal than tip of snout.

b. Ridges on head mostly smooth, the upper lateral ridges of snout usually slightly serrate; superior ridges of snout close together and nearly parallel, little if at all divergent on anterior half, approaching each other anteriorly and meeting at tip of upper jaw; color in spirits pale brown; greenish brown in life, with a series of blue spots along side from snout to base of caudal; another series of smaller blue spots on back close to vertebral line. *tabacaria*, p. 250.

bb. Ridges on head more or less serrate; upper lateral ridges of snout always with evident serræ.

c. Sculpturing of head weak, the median furrow in upper surface shallow; upper lateral ridges of snout with rather small serræ; superior ridges far apart, divergent on anterior half, then approaching each other and meeting at tip of upper jaw; skin smooth; the armature of lateral line weak; color in spirits very dark brown; greenish brown in life, with a narrow blue line, more or less interrupted anteriorly, and posteriorly extending from nape to base of caudal; a series of blue spots on back close to vertebral line. *depressa*, p. 251.

cc. Sculpturing of head more prominent, the median furrow in its upper surface deeper; upper lateral ridges of snout close together, and nearly parallel, little if at all divergent on anterior half; skin rough; the armature of lateral line well developed; color in spirits pale brown (probably reddish in life), with darker cross-bars. *petimba*, p. 252.

186. Fistularia corneta Gilbert & Starks.

Fistularia corneta Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 56, Pl. X, figs. 18 and 18a (Panama).

Head 2.7 to 3.0; depth in front of pectorals 10.0 to 10.9 in head; D. 17 or 18; A. 16 or 17.

Body very elongate, much depressed; head more or less quadrate, only slightly wider than deep; snout shorter than in other species of this genus, its upper lateral ridges with small serræ on posterior half, the superior ridges far apart, parallel posteriorly, sometimes diverging slightly on anterior half of snout, then gradually approaching each other and meeting at tip of snout; snout 1.4 to 1.5 in head; eye 10.2 to 12.0; interorbital (bone) broad, 3.9 to 4.45 in postorbital part of head, with a wide, shallow, and perfectly smooth median furrow, rough with elevated ridges at the sides; serræ over posterior part of orbit and in

front of eye small and blunt; lower surface of head and snout entirely without serræ; mouth small, oblique; lower jaw projecting; maxillary posteriorly concave, 13.0 to 14.9 in head; skin perfectly smooth; no bony plates in the lateral line; dorsal and anal similar, placed directly opposite each other, their longest rays a little shorter than postorbital part of head; caudal fin forked, the lobes of equal length, the median ray produced into a long filament; ventral fins small, about two-thirds the length of pectorals, inserted slightly nearer tip of snout than base of caudal; pectoral fins short, 8.0 to 8.42 in head.

Color nearly uniform dark brown above, pale below.

There are 31 specimens, ranging from 365 to 535 mm. in length, in the present collection. We have examined other specimens collected by the "Albatross" at Mazatlan and Panama. It is readily distinguished from all other species of this genus by the wide interorbital with the perfectly smooth median furrow. The snout is shorter, the mouth smaller, the dorsal and anal fins are slightly longer, and the lateral line is entirely unarmed.

Known from Mazatlan and Panama. Our specimens are from Taboga Island, and Balboa. All, except one, were collected at Taboga Island, where the species seems to be rather common and where they were taken in a small seine along a sandy shore, usually one or two to a haul.

187. Fistularia tabacaria Linnæus.

Fistularia tabacaria Linnæus, Syst. Nat., Ed. X, 1758, 312; Bloch, Ichthyol., 1794, Pl. CCCLXXXVII, fig. 1; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 757; Evermann & Marsh, Bull. U. S. Fish Comm., XX, Pt. I, 1900 (1902), 106; Sumner, Bull. U. S. Fish Comm., XXXI, Pt. II, 1911 (1913), 746.

Fistularia neoboracencis Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 437 (New York).

Flagellaria fistularis Gronow, Cat. Fish, 1854, 146 (American Ocean).

Aulastome marcgravii Castelnau, Anim. Nouv. Rares Amér. Sud, 1855, 30 (Bahia; Rio Janeiro).

Fistularia tabaccaria Günther, Cat. Fish. Brit. Mus., III, 1861, 529; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 389.

Head 2.6 to 2.8; depth 9.8 to 15.0 in head; D. 13 to 15; A. 13 to 15.

Body very elongate, strongly depressed; head nearly quadrate, slightly wider than deep; snout very long, its upper lateral ridges nearly smooth; the superior ridges rather close together, and parallel, gradually approaching each other anteriorly and meeting at tip of

upper jaw, 1.35 to 1.4 in head; orbit 9.6 to 11.7; interorbital (bone) rather narrow, 4.7 to 6.2 in postorbital part of head, deeply concave, the median furrow occupying its entire width, little striate; serræ over posterior portion of orbit and in front of eye almost completely wanting; lower surface of head and snout little rugose; mouth moderate, slightly oblique; lower jaw projecting, maxillary concave posteriorly, 8.4 to 11.4 in length of head; skin slightly rough; lateral line posteriorly armed with small bony scutes, these not evident in very young; dorsal and anal similar, and directly opposite each other, their longest rays equal to postorbital part of head; caudal forked, the lobes of equal length, with the median ray produced into a long filament; ventral fins about two-thirds the length of pectorals, inserted much nearer the base of caudal than tip of snout; pectoral fins rather short, 8.0 to 9.5 in head.

Color in life greenish brown above; pale below; sides with a row of blue spots from snout to base of caudal; a row of smaller blue spots close to vertebral line of back; sides and back with about 10 cross-bars, a little darker than the ground color; caudal filament deep blue; the blue spots and the bars rapidly disappearing in preserved specimens, leaving the back uniform brown.

This species is represented by 2 specimens, 135 and 240 mm. in length. We have compared these with numerous specimens from the eastern coast of the United States. It is distinguished from *F. depressa* and *F. petimba* by the almost complete absence of serrations on the head and snout. The superior ridges on the snout are arranged as in *F. petimba,* but the sculpturing of the head is less prominent.

Known from the Atlantic coast of America, from Massachusetts south to Rio Janeiro. Our specimens are from Fox Bay, Colon.

188. Fistularia depressa Günther.

Fistularia depressa Günther, Shore Fishes, Challenger, 1880, 69, Pl. XXXII, fig. D (Sulu Islands, Natal, Zanzibar, Amboyna, China, New Guinea, New South Wales, Fiji, Lower California); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 757; Jordan & Starks, Proc. U. S. Nat. Mus., 1903, 66; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 55 (Panama).

Fistularia petimba Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, Pt. I, 1903 (1905), 116; Snyder, Proc. U. S. Nat. Mus., 1912, 408.

Head 2.6 to 2.84; depth 9.6 to 12.0 in head; D. 14 to 16; A. 13 to 15.

Body very elongate, strongly depressed; head depressed, notably wider than deep; snout very long, its upper lateral ridges with rather

small serræ on posterior two-thirds, the superior ridges rather far apart, diverging on anterior half of snout, then approaching each other gradually and meeting at tip of upper jaw; snout 1.3 to 1.4 in head; orbit 9.8 to 12.0; interorbital (bone) rather narrow, 4.9 to 5.75 in postorbital part of head, the median furrow with a narrow ridge in the center, the sides rather strongly striate; serræ over posterior part of orbit and in front of eye short and blunt; lower surface of head and snout smooth, without serræ; mouth moderate, oblique; lower jaw projecting; maxillary posteriorly concave, 8.9 to 12.0 in head; skin smooth; lateral line posteriorly with weak bony scutes, these not visible in young; dorsal and anal similar, and directly opposite each other, their longest rays a little shorter than postorbital part of head; caudal fin forked, the lobes of equal length, with the median ray produced into a long filament; ventral fins small, about two-thirds the length of pectorals, inserted notably nearer base of caudal than tip of snout; pectoral fins short, 8.1 to 10.6 in head.

Color in spirits very dark brown above, pale below; a series of blue spots in front of the dorsal on each side of median line of back; back of dorsal a single series of spots occupies the median line of back; a more or less interrupted blue, lateral stripe is also present.

Of this species only 2 large specimens, 750 and 885 mm. in length, and 2 small ones, 150 to 200 mm. long, were secured. We have compared them with specimens from Japan and Hawaii, with which they seem to agree perfectly.

Recorded from Zanzibar, the East Indies, Australia, China, Japan, Hawaii and the Pacific coast of America from Lower California south to Panama. Our specimens are from Naos Island and Panama market.

189. Fistularia petimba Lacépède.

Fistularia tabacaria Bloch, Ichthyol., 1794, Pl. CCCLXXXVII, fig. 2 ("Coll. Linke at Leipzig," wrongly figured as spotted with blue; 2 caudal filaments).

Fistularia petimba Lacépède, Hist. Nat. Poiss., V. 1803, 349 (New Britain, Isle of Reunion, equatorial Pacific; based on specimens and manuscripts of Commerson; snout serrate; body immaculate); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 758; Jordan & Starks, Proc. U. S. Nat. Mus., 1903, 67.

Fistularia serrata Cuvier, Règne Animal, Ed. I, II, 1817, 349 (after Bloch); Günther, Cat. Fish. Brit. Mus., III, 1861, 533, and Shore Fishes, Challenger, 1880, 68, Pl. XXXII, fig. C; Jordan &

Evermann, Bull. U. S. Fish. Comm., XXIII, Pt. I, 1903 (1905), 116; Snyder, Proc. U. S. Nat. Mus., 1912, 408.

Fistularia immaculata Cuvier, Règne Animal, Ed. I, II, 1817, 349 (Sea of the Indies; after Commerson and John White).

Fistularia commersonii Rüppel, Neue Wirbelthiere, 1835, 142 (Red Sea).

Head 2.5 to 2.7; depth in front of pectorals 12 to 18.8 in head; D. 14 or 15; A. 14 or 15.

Body very elongate, and very strongly depressed; head somewhat quadrate, not much wider than deep; snout very long, its upper lateral ridges with sharp serræ on posterior three-fourths, the superior ridges close together, and nearly parallel, not diverging perceptibly on anterior half of snout, meeting each other at tip of upper jaw; snout 1.3 to 1.4 in head; orbit 11.0 to 15.0; interorbital (bone) narrow, 4.45 to 6.85 in postorbital part of head, deeply concave, the median furrow occupying nearly the entire width, the middle of furrow with a slight ridge, the sides with rather prominent ridges; serræ over posterior part of orbit and in front of eye sharp; lower surface of head and snout rugose, the ridges slightly serrate; mouth rather small, very slightly oblique; lower jaw projecting; maxillary posteriorly concave, 9.75 to 15 in head; skin rough, feeling harsh like fine shagreen; the lateral line posteriorly armed with strong bony scutes, present at all ages; dorsal and anal similar, placed directly opposite each other, their longest rays a little longer than postorbital part of head; caudal forked, the lobes of equal length, with the median ray produced into a long filament; ventral fins small, about two-thirds the length of pectorals, inserted much nearer base of caudal than tip of snout; pectoral fins short, 9.7 to 10.8 in head.

Color of our small specimen pale brown in alcohol, probably reddish in life; with indistinct cross-bars. Of these bars there are about 8 on the snout and about 20 on the body.

A single small specimen, 105 mm. in length, represents this species in the present collection. We have compared it with several specimens from Japan, one specimen from the Philippine Islands, and 3 specimens from the Hawaiian Islands. There is a specimen from Rhode Island in the National Museum which undoubtedly also belongs to this species. The above description is based on all of the specimens examined which range in length from 105 to 475 mm., exclusive of caudal filament. The old alcoholic specimens at hand have no trace of the cross-bars left, but that these are normally present in fresh material is indicated by a description by Jordan & Starks (Proc. U. S.

Nat. Mus., 1903, p. 67) based on specimens from Japan. This species may be distinguished from *F. depressa* by the less strongly depressed head, and by the stronger sculpturing of its upper surface. The median furrow of the interorbital is deeper; the superior ridges on the snout are closer together and more nearly parallel. The serrations on the head and snout are notably stronger; the skin is rough, the armature of the lateral line is much stronger; the dorsal and anal are a little higher, and the color of the body is notably lighter.

Recorded from nearly all warm seas. Heretofore not recorded from the Pacific coast of America. On the Atlantic coast it has been recorded from Bermuda and Massachusetts. Massachusetts records were, however, later referred to the synonomy of *F. tabacaria.* Our specimen was taken at Chame Point, by Mr. Robert Tweedlie.

Order XIII. Lophobranchii.

Family XXXIV. Syngnathidæ.

THE PIPE-FISHES.

Body elongate, covered with bony rings which are firmly connected; snout long, shaped like a tube, bearing the small mouth at its tip; jaws toothless; gill-openings reduced to a small aperture near upper angle of opercle; tail long, sometimes prehensile. Males with an egg pouch, usually placed on the under side of the tail, sometimes under the abdomen, commonly formed by two folds of skin which meet on the median line. The eggs are received into this pouch and there retained until after hatching, when it opens, permitting the young to escape. Dorsal fin simple, of soft rays only; caudal fin, if present, small; anal usually present, minute; ventrals none; pectorals small or wanting.

KEY TO THE GENERA.

a. Tail prehensile; the head shaped like that of a horse, placed nearly at a right angle to axis of body. *Hippocampus,* p. 255.

aa. Tail not prehensile; the head elongate, not shaped like that of a horse, usually in line with the axis of the body.

b. Males with the egg pouch under the tail; ridges on body not especially prominent; tail usually longer than rest of body. *Syngnathus,* p. 256.

bb. Males with the egg pouch under the abdomen; ridges on body prominent; tail shorter than rest of body. *Doryrhamphus,* p. 261.

74. Genus **Hippocampus** Rafinesque.

Hippocampus Rafinesque, Caratteri, etc., 1810, 18 (type *Syngnathus hippocampus* Linnæus).

Body compressed, tapering abruptly into a long quadrangular, prehensile tail; head placed nearly at a right angle to the body, shaped remarkably like that of a horse; top of head with a star-shaped coronet; egg pouch in males placed at base of tail, just back of vent; dorsal fin moderate, placed over vent; anal fin small, usually present; pectorals short and broad.

KEY TO THE SPECIES.

a. Dorsal rather short, with 16 to 18 rays; placed over 2 + 1 or 2 rings, its base 2.8 to 3.1 in head; rings 11 or 12 + 34 or 35. *punctulatus*, p. 255.

aa. Dorsal slightly longer, with 18 or 20 (usually 19) rays, placed over 2½ or 3 + 1 or 1½ rings, its base 1.95 to 2.3 in head; rings 12 or 13 + 36 to 39. *ingens*, p. 256.

190. **Hippocampus punctulatus** Guichenot.

Hippocampus punctulatus Guichenot, in Sagra, Hist. Phys. Polit. Nat. Cuba., IV, Pt. II, 1853, 174, Pl. V, fig. 2 (Cuba); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 777.

Hippocampus marginalis Heckel, in Kaup, Cat. Lophobr. Fish, 1856, 15 (Mexico).

Hippocampus fascicularis Heckel, in Kaup, Cat. Lophobr. Fish, 1856, 15 (Mexico).

Hippocampus longirostris Kaup, Cat. Lophobr. Fish, 1856, 12 (not of Cuvier).

Hippocampus guttulatus Günther, Cat. Fish. Brit. Mus., VIII, 1870, 202 (probably not of Cuvier).

Depth 1.4 to 1.85 in head; D. 16 to 18; A. 4; rings 11 or 12 + 34 or 35.

Body with blunt spines, which grow shorter with age, and not bearing cirri; rings with short dermal flaps, these most evident in young; head with rather high spines, bearing no cirri; skin on head and snout with dermal papillæ or small flaps; snout about as long as rest of head, directed upward at the tip, 1.9 to 2.3 in head; eye 5.1 to 6.6; the small mouth vertical; dorsal fin over 2 + 1 or 2 rings, its base 2.8 to 3.1 in head; anal fin small; pectorals broader than long, 5.6 to 7.7 in head.

Color of specimens at hand plain dark brown. Specimens from other localities, which we have examined, are often much spotted.

This species is represented by 3 female specimens, ranging in length from about 55 to 85 mm., and they form the basis for the above description.

Known from the tropical parts of the Atlantic, from America to Africa. Our specimens are from Colon and Porto Bello.

191. Hippocampus ingens Girard.

Hippocampus ingens Girard, (House of Repr. Ex. Doc. No. 91) Rept. Expl. & Surv. Miss. R. to Pac. O., X, Pt. IV, 1858, 342 (San Diego); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 776; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 57 (Panama Bay).

Hippocampus gracilis Gill, Proc. Ac. Nat. Sci. Phila., 1862, 282 (Cape San Lucas).

Depth 1.4 to 2.85 in head; D. 18 to 20; A. 4 or 5; rings 12 or 13 + 36 to 39.

Body with blunt spines, bearing no cirri; rings with papillæ and small dermal flaps, these most evident in young; the depth increasing greatly with age; head with high spines, bearing no cirri, the snout usually about as long as rest of head, 1.95 to 2.3 in head; eye 5.2 to 7.2; the small mouth almost vertical; egg pouch rather short, occupying 8 or 9 rings; dorsal over 2½ or 3 + 1 or 1½ rings, its base 1.95 to 2.3 in head; anal fin minute; pectorals about as wide as long, 5.2 to 6.2 in head.

Color very variable, sometimes plain blackish, others brownish with darker spots and numerous white dots, which often form wavy lines. One of our specimens, a female, is of light brown, with fewer black spots; the white points are also much fewer, and the body is crossed by 12 pale bars. Of this species we have 9 (4 male and 5 female) specimens, ranging in length from about 45 to 180 mm.

Known from California southward to Panama Bay. Our specimens are from Chame Point and the Panama market.

75. Genus **Syngnathus** Linnæus.

Syngnathus Linnæus, Syst. Nat., Ed. X, 1758, 336 (type *Syngnathus acus* Linnæus).

Siphostoma Rafinesque, Caratteri, etc., 1810, 18 (type *Syngnathus pelagicus* Linnæus).

Body very elongate, 6 or 7 angled, not compressed, tapering into a long tail; head slender; snout long, tube-like, bearing the very small

toothless mouth at its tip; humeral bones firmly united to the "breast ring"; dorsal fin distinct; caudal fin present, rather small; anal fin, if present, minute, placed close behind vent; pectorals present, short and rather broad. Male fishes with the egg pouch along the under side of the tail.

KEY TO THE SPECIES.

a. Snout long and slender, longer than rest of head, 1.6 to 1.95 in head; dorsal over 4 or 5 caudal rings.

b. Head and snout very long, 6.1 to 6.65 in length; body of females rather deep, the abdomen with a prominent keel, which has a black edge; males more slender, the abdomen convex but without a prominent keel; pectorals short, scarcely longer than wide, 7.5 to 8.7 in head. *mackayi*, p. 257.

bb. Head and snout shorter, 7.5 to 8.5 in length; body of both males and females very slender, the abdomen convex, but without a distinct keel; pectoral fins notably longer than wide, 5.0 to 5.8 in head. *rousseau*, p. 258.

aa. Snout less slender, equal to or shorter than rest of head, 2.0 to 2.6 in head; dorsal over 6 to 8 caudal rings.

c. Head and snout rather long, 6.6 in length; dorsal fin short, with 24 rays, its base shorter than head, 9.1 in length; anal fin present; caudal fin emarginate. *tweedliei* sp. nov., p. 259.

cc. Head and snout shorter, 9.2 to 10.5 in length; dorsal fin long, with 30 rays or more, its base longer than head, 6.6 to 8.8 in length; anal fin wanting; caudal fin rounded.

d. Dorsal fin moderate, with 30 to 32 rays, its base 8.1 to 8.8 in length; caudal rings about 37 or 38 in number. *elcapitanense*, p. 260.

dd. Dorsal long, with 35 rays, its base 6.6 in length; caudal rings about 47. *mindii* sp. nov., p. 261.

192. Syngnathus mackayi (Swain & Meek).

Siphostoma MacKayi Swain & Meek, Proc. U. S. Nat. Mus., 1884, 239 (Key West).

Siphostoma mackayi Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 766.

Head 6.1 to 6.65; depth in females 16 to 19, males 21 to 28; D. 26 to 28; rings 16 or 17 + 32 to 37.

Body of females rather deep, with a prominent ventral keel in front of vent, ventral surface flat back of vent; males more slender,

ventral surface in front of vent only slightly convex, and without a distinct keel; caudal portion long, 1.6 to 1.9 in length of body; top of head with a slight ridge; snout longer than rest of head, with a low ridge above, 1.6 to 1.75 in head; eye 8.1 to 9.7; opercles with a slight ridge in front, with pits of radiating lines; caudal pouch of males short, about 4.7 in body, occupying 13 rings; dorsal inserted in advance of vent, over 1½ or 2 + 4 or 5 rings, its base about equal to length of snout, its base 10 to 10.5 in body; anal fin with only 2 or 3 rays, scarcely as long as eye; caudal fin well developed, rounded, the median rays the longest; pectorals short, scarcely as long as wide, 7.5 to 8.7 in head.

Color in life, of female, brown, with yellowish above, yellowish green below; a dark line on abdominal keel; a wide and less distinct dark band on ventral surface back of vent; a dark green streak from snout through eye to pectoral; sides with blue bars, these becoming broken up into blue and brown dots on caudal portion; dorsal with brown dots, these often forming bars at right angles to the rays; caudal brown, with blue dots. The males without dark abnominal streak, and always with fewer bars and more numerous dots.

This species is represented by 5 male and 15 female specimens, ranging from 140 to 215 mm. in length. We have compared them with the type, with which they agree in all particulars, except that the dorsal fin is slightly shorter in our specimens. The type has 29 dorsal rays, and the base of dorsal is contained 9.0 times in length of body.

Known from Florida southward to Panama. Previously not recorded south of Yucatan. Our specimens are from Colon and Porto Bello.

193. Syngnathus rousseau Kaup.

Syngnathus rousseau Kaup, Cat. Lophobr. Fish, 1856, 40 (Martinique).
Siphostoma rousseau Jordan, Proc. U. S. Nat. Mus., 1889, 647; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 767.

Head 7.5 to 8.5; depth 25 to 37; D. 26 to 28; rings 17 or 18 + 32 to 35.

Body of both males and females very slender, increasing in depth with age; ventral surface in front of vent slightly convex, without a definite keel, back of vent distinctly concave; caudal portion long, 1.7 to 1.8 in length of body; top of head with a rather prominent keel; snout longer than rest of head, with a keel above, 1.85 to 1.95 in head; eye 6.8 to 8.7; opercles without a definite ridge; caudal pouch of

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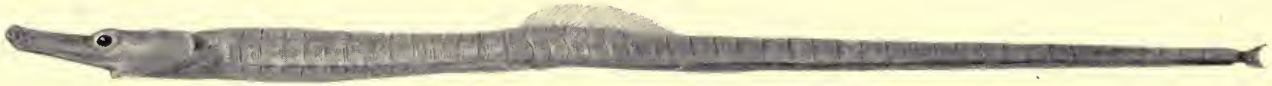

FIG. 1. SYNGNATHUS TWEEDLIEI sp. nov.
From the type 75 mm. in length.

FIG. 2. SYNGNATHUS MINDII sp. nov.
From the type 95 mm. in length.

males very short, 4.75 in body, occupying 12 rings; dorsal inserted in advance of vent, over 2 + 4 or 5 rings, its base 9.5 to 11 in length of body; anal fin very small, composed of only 2 or 3 rays, which are about as long as eye; caudal fin well developed, rounded, the median rays the longest; pectorals moderate, notably longer than wide, 5.0 to 5.8 in head.

Color brownish; some specimens almost plain, others with numerous pale dots, and more or less distinct pale cross-bars; a dark band on snout through eye to pectoral fin; dorsal with dark vertical bars; caudal brownish.

We have identified 21 specimens, 6 males and 15 females, ranging in length from 70 to 210 mm., as this species. We have in this connection examined the few available specimens of the closely related *S. pelagicum* from the Bahamas, West Indies and Genoa. This is apparently a very varied species, and it does not seem improbable that *S. rousseau* may prove to be only a slender variety of the former. We have also for comparison a specimen identified as *S. rousseau* by Jordan (Proc. U. S. Nat. Mus., 1889, 647) from St. Lucas, W. I. This specimen has a somewhat shorter head (7.2 in length); the dorsal is over 1 + 6 rings, and the caudal pouch occupies only 11 rings.

Known only from the West Indies. The range is now extended to Panama. Our specimens are from Toro Point, Colon and Porto Bello.

194. Syngnathus tweedliei sp. nov. (Plate XVIII, fig. 1.)

Type No. 82088, U. S. N. M.; length 75 mm.; Chame Point, Panama.

Head 6.6; depth 24; D. 24; rings 15 + 32.

Body slender, the caudal portion much the longer, 1.75 in length without caudal fin; the ventral surface in front of vent convex, with a blunt keel, back of vent notably concave; the top of head with a slight keel; snout as long as the rest of head, carinate above, 2 in head; eye 9.6; opercles with a slight ridge in front, with radiating striæ; origin of dorsal over vent, occupying 1 + 6 rings, its base shorter than head, 9.1 in length of body; anal fin present, very small, with two rays which are scarcely as long as the eye; caudal fin emarginate, the outer rays the longest, about equal to length of eye; pectoral fins scarcely longer than wide; 5.8 in length of head.

Color plain grayish, caudal portion slightly darker than rest of body.

The type and only specimen is a female 75 mm. long. It was taken at Chame Point by Mr. Robert Tweedlie, for whom the species is named.

195. Syngnathus elcapitanense (Meek & Hildebrand). (Plate XIX.)

Siphostoma auliscus Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 57 (not of Swain; Panama).

Siphostoma elcapitanense Meek & Hildebrand, in Meek, Field Mus. Nat. Hist. Pub., Zoöl. Ser., X, 1914, 119 (El Capitan, Panama; Jesus Mariá and Turrubales, Costa Rica).

Type No. 81735, U. S. N. M.; length 150 mm.; Rio Mamoni, El Capitan, Panama.

Head 9.5 to 10.5; depth 19 to 34; D. 30 to 32; rings 14 + 37 or 38.

Body slender, the depth varying greatly with age and sex, the young and the males being much more slender; caudal portion very long, 1.5 to 1.6 in length without caudal; ventral surface in front of vent convex, with a blunt keel, flat behind vent; top of head with a feebly developed ridge; snout slightly shorter than rest of head, comparatively shorter in young than in adult, carinate above, 2.15 to 2.6 in head; eye 6 to 9.3; opercles with a slight ridge, extending from shortly back of eye to its upper anterior angle; caudal pouch of males short, 3.4 to 3.8 in length of body, occupying 15 or 16 rings; origin of dorsal over or in ring behind vent, occupying 7 or 8 rings; base of dorsal longer than head, 8.1 to 8.8 in length of body; anal fin wanting; caudal fin rounded, the median rays the longest, about as long as postorbital portion of head; pectorals scarcely longer than wide, 4.2 to 5.5 in length of head.

Color mostly grayish; marked and spotted with pearly gray and dark spots.

Of this species we have 2 male and 9 female specimens, ranging in length from 50 to 150 mm. It resembles *S. auliscus* Swain (Proc. U. S. Nat. Mus., 1882, 310), but it has a shorter head, fewer body rings; the dorsal is situated wholly on the caudal portion of body, its base is apparently longer; the caudal pouch of males is much shorter and the anal fin is wholly wanting.

Our specimens are from Chame Point, Rio Calobre, Rio Mamoni at El Capitan and Chepo, and Rio Tuyra at Boca de Cupe. All, except one specimen from the first named locality, are from fresh water. The species also is reported from Costa Rica.

a

b

SYNGNATHUS ELCAPITANENSE (Meek & Hildebrand).

a. Male. From the type 150 mm. in length.
b. Female. From a paratype 155 mm. in length.

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196. Syngnathus mindii sp. nov. (Plate XVIII, fig. 2.)

Type No. 81770, U. S. N. M.; length 95 mm.; creek near Mindi, Canal Zone.

Head 9.2; depth 30; D. 35; rings 14 + 47.

Body of male very slender; ridges rather blunt, without spines; ventral surface in front of vent convex, with a slight keel; caudal portion much longer than rest of body, 1.55 in length of body; top of head with a slight ridge; snout very short and blunt, depressed, equal to postorbital portion of head, with a rather prominent ridge above, 2.5 in head; eye 6.65; opercles without a definite ridge, with many radiating lines; caudal pouch short, 4.1 in length of body, occupying 14 rings; dorsal inserted over vent, over 1 + 8 rings, its base notably longer than head, 6.6 in length of body; anal fin wanting in the specimen at hand; caudal fin well developed, slightly rounded; pectorals somewhat longer than wide, 5.0 in head.

Color in life, light brown; ventral surface in front of vent greenish; egg pouch reddish brown; a brown bar on snout through eye; dorsal and pectorals yellowish; caudal fin black with a yellowish margin.

Of this species we have but a single specimen, a male 95 mm. long, which was taken in a brackish creek at Mindi.

76. Genus **Doryrhamphus** Kaup.

Doryrhamphus Kaup, Archiv. Naturg., XXXIII, 1853, 233, and Cat. Lophobr. Fish, 1856, 54 (type *Doryrhamphus excisus* Kaup).

Pectoral fins well developed; ridges of body prominent; tail shorter than rest of body. *Egg pouch of males under abdomen.*

197. Doryrhamphus lineatus (Valenciennes).

Doryichthys lineatus Valenciennes, MS., in Kaup, Cat. Lophobr. Fish, 1856, 59 (Bahia, Mexico, and Guadeloupe).

Doryichthys aculeatus Kaup, Cat. Lophobr. Fish, 1856, 61 (Egypt).

Doryrhamphus lineatus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 773; Eigenmann, Memoir. Carnegie Mus., V, 1912, 463.

Head 4.85 to 5.6; depth 18 to 31; D. 40 to 43; rings 19 or 20 + 22 or 23.

Body slender, increasing in depth with age, the young extremely slender; caudal portion shorter than rest of body, 2.45 to 2.6 in length; ventral surface in females with a keel in front of vent, flat behind

vent; body ridges prominent, with sharp spines in the young, these become blunter and finally disappear with age; lateral line uninterrupted, passing into the lower ridge of tail; top of head with three ridges; snout very much longer than rest of head, with several ridges, the tip directed upward, 1.5 to 1.75 in head; eye 8 to 9.6; the small mouth vertical; opercles with one evident ridge and 2 or 3 smaller ones; egg pouch of male occupying all of the body rings except the anterior two; dorsal long, inserted in advance of vent, over 2 or 3 + 5½ or 6 rings, its base somewhat longer than snout, 7.0 to 8.35 in length of body; anal very small, with only 1 or 2 rays, which are shorter than eye; caudal rounded, the median rays the longest, slightly shorter than postorbital portion of head; pectorals wider than long; snout equal to length of eye.

Color in life very dark greenish brown; sides with a very narrow silvery stripe just below lateral line, wanting in young; snout mostly reddish, its sides with 4 or 5 black spots, these faint or wanting in young individuals.

Of this species we have 66 (6 male and 60 female) specimens, ranging in length from 85 to 150 mm. All were taken in slightly brackish creeks.

A widely distributed species, known from the tropical parts of the Atlantic from America and Africa. Our specimens are from Toro Point and Mindi.

Order XIV. Acanthopteri.

Family XXXV. Atherinidæ.*

THE SILVERSIDES.

Body rather elongate, more or less compressed; cleft of mouth moderate or rather small; teeth small, present on jaws, sometimes on vomer and palatines, rarely wanting; gill-membranes separate, free from the isthmus; gills 4, a slit behind the fourth; branchiostegals 5 or 6; pseudobranchiæ present; scales moderate or small, cycloid or not; no pyloric cæca; air bladder present; vertebræ rather numerous, usu-

*The study of this family was completed and the manuscript prepared before Jordan & Hubb's work, "A Monographic Review of the Family of *Atherinidæ* or Silversides" (Leland Stanford Junior University Publications, University Series, 1919, 87 pages, 11 plates with 40 figures), was published. The genera as understood and used in the present paper, therefore, do not agree with this recent work, in which further divisions were made. The reader is referred to the above mentioned paper for a more detailed study of the generic relationships of the genera of *Atherinidæ*.

ally about 46; dorsal fins 2, the first with 3 to 9 flexible spines, the second with one weak spine and soft rays; anal with one weak spine, usually longer than second dorsal; ventrals abdominal, 1 small spine and 5 soft rays; pectorals moderate, inserted high.

KEY TO THE GENERA.

a. The premaxillaries nearly straight; body little compressed; vomer with teeth. *Atherina,* p. 263.
aa. The premaxillaries strongly curved; the body compressed; vomer without teeth.
b. Abdomen compressed, forming a keel; outer teeth in upper jaw curved, forming hooks. *Atherinella,* p. 265.
bb. Abdomen not compressed into a keel, more or less rounded in section; outer teeth in upper jaw never distinctly hooked.
c. Body elongate; sides with a well defined band; first dorsal with fewer than 8 spines.
d. Scales smooth. *Menidia,* p. 266.
dd. Scales crenate. *Kirtlandia,* p. 268.
cc. Body deep; the lateral band absent; first dorsal with 7 to 9 spines. *Mugilops* gen. nov., p. 271.

77. Genus **Atherina** Linnæus.

Atherina Linnæus, Syst. Nat., Ed. X, 1758, 315, (type *Atherina hepsetus* Linnæus).

Body oblong, somewhat compressed; mouth large, oblique, terminal; the lower jaws included; the premaxillaries narrow posteriorly, nearly straight, strongly protractile; villiform teeth present on jaws, vomer, and palatines.

KEY TO THE SPECIES.

a. Body short and thick, depth 4.6 to 5.2 in length; head low and broad, as wide as deep; snout very short and blunt; eye large, 2.2 to 2.4 in head; lateral band narrow, about the width of pupil; scales 36 to 38. *stipes,* p. 264.
aa. Body elongate, depth 5.5 to 6.6 in length; head compressed, deeper than wide; snout longer and pointed; eye small, 2.4 to 2.75 in head; lateral band more than half the width of eye; scales 42 to 45. *aræa,* p. 264.

198. Atherina stipes Müller & Troschel.

Atherina stipes Müller & Troschel, in Schomburgk, Hist. Barbados, 1848, 671 (Barbados); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 790, Pl. CXXII, fig. 332.

Atherina laticeps Poey, Memorias, II, 1861, 265 (Havana).

Atherina velieana Goode & Bean, Proc. U. S. Nat. Mus., 1879, 342 (Clear Water Harbor, Florida).

Head 3.5 to 3.8; depth 4.6 to 5.2; D. IV or V-I, 8 to 10; A. I, 11 or 12; scales 36 to 38.

Body short and thick, not much compressed; head depressed above, as wide as deep; interorbital space nearly as wide as eye, 2.35 to 2.75 in length of head; snout very short and blunt, 4.15 to 4.7 in head; eye 2.2 to 2.4; lower jaw included; mouth oblique, the gape reaching past anterior margin of eye; gill-rakers somewhat less than half as long as eye, about 15 on lower limb of first arch; teeth on the jaws and vomer in villiform bands, none of them especially enlarged; scales smooth or slightly crenate; dorsal and anal more or less scaly; first dorsal much in advance of origin of anal, inserted about midway between middle of eye and base of caudal; pectorals shorter than head, 4.4 to 5.15 in length of body.

Color greenish above, pale silvery below; sides with a well defined band which occupies the third row of scales, and is about as wide as pupil; each scale on back and sides with a dark speck, these forming streaks along the rows of scales, most prominent on median row on back.

Numerous specimens, ranging from 35 to 70 mm. in length, were taken. We have compared them with numerous specimens from Cozumel, Cuba, Porto Rico, the Bahamas, and Florida, with which they are identical.

Known from Florida southward to Panama. Our specimens are from Toro Point, Colon, and Porto Bello.

199. Atherina aræa Jordan & Gilbert.

Atherina aræa Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 27 (Key West, Florida); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 790, Pl. CXXIII, fig. 333.

Head 4.25 to 4.6; depth 5.5 to 6.6; D. V or VI-I, 9 or 10; A. I, 10 to 13; scales 42 to 45.

Body elongate, moderately compressed; head compressed, not as wide as deep; interorbital space slightly narrower than eye, 2.75 to 3.2 in length of head; snout pointed, its length 3.55 to 4 in head; eye

2.4 to 2.75; mouth moderate, oblique, the gape reaching about anterior margin of eye; gill-rakers less than half the length of eye, about 18 on lower limb of first arch; teeth all small, present on jaws and vomer; scales all entire; dorsal and anal without scales; first dorsal much in advance of origin of anal, inserted slightly nearer base of caudal than tip of snout; pectorals short, notably shorter than head, 5.5 to 6.6 in length of body.

Color greenish above, silvery below; sides with a prominent band which occupies the third row of scales, and is more than half the width of eye; each scale on back with a dark speck, these forming more or less distinct lines along the rows of scales.

Of this species we have 29 specimens, ranging in length from 45 to 65 mm. We have for comparison specimens from Cozumel; Watlings Island; and the type from Key West, Florida.

Known from Florida southward to Panama. Our specimens are from Porto Bello.

78. Genus **Atherinella** Steindachner.

Atherinella Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXI) Ichth. Beitr., II, 1875, 35 (type *Atherinella panamensis* Steindachner).

Body elongate; abdomen compressed, forming a keel; mouth oblique; teeth in the jaws pointed and hooked; scales strongly ctenoid; the first dorsal inserted slightly back of origin of anal; the second dorsal inserted over the last anal rays; pectorals very long.

200. **Atherinella panamensis** Steindachner.

Atherinella panamensis Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXI) Ichth. Beitr., II, 1875, 35 (Panama); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 805; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 59, Pl. IX, fig. 17 (Panama Bay).

Head 4.8; depth 4.5; D. III-I, 7; A. I, 21; scales 37 or 38.

Upper profile, from tip of snout to second dorsal, horizontal; ventral profile, from articulation of mandible to last anal rays, convex; head broad and flat above; the interorbital space 2.75 in length of head; snout 3.33; eye 3.66; mouth oblique; lower jaw included; teeth in the jaws in several rows, the outer row enlarged, those of upper jaw strongly hooked and occupying the outer margin of the jaw; first dorsal inserted over about the tenth anal ray; pectorals greatly developed, falcate, much longer than the head, contained 2.75 times in length of body.

Sides with a grayish silvery band which has a dark margin above.

This rare species was not seen by us. Known from only two specimens from Panama Bay, the type described by Steindachner in 1875 and one specimen secured by the Hopkins Expedition from the Leland Stanford Junior University in 1896.

79. Genus **Menidia** Bonaparte.

Menidia Bonaparte, Icon. Fauna Ital., Pesci, III, about 1836, Fasc. 91 (no type indicated, *Atherina menidia* Linnæus doubtlessly intended).

Argyrea De Kay, Fauna N. Y., Fishes, 1842, 141 (type *Atherina notata* Mitchill; name preoccupied).

Body elongate, more or less compressed; belly before ventrals rounded, not compressed into an edge or keel; the mouth small, very oblique; the premaxillaries much curved; jaws each with a band of simple and usually villiform teeth; no teeth on vomer or palatines; premaxillaries protractile; both dorsals short; *scales rather large, entire.*

KEY TO THE SPECIES.

a. Body very elongate, slender, the depth 6.1 to 6.9 in length; anal without a sheath of scales at base, with I, 20 to 23 rays; lateral band narrow, scarcely as wide as pupil.
chagresi, p. 266.

aa. Body rather deep, the depth 4.3 to 4.8 in length; anal with a wide sheath of scales at base, with I, 24 to 28 rays; lateral band wide, about three-fourths as wide as eye.
starksi sp. nov. p. 267.

201. Menidia chagresi Meek & Hildebrand. (Plate XX, fig. 1.)

Thyrina pachylepis Evermann & Goldsborough, Proc. Biol. Soc. Wash., XXII, 1909, 102 (not of Günther).

Menidia chagresi Meek & Hildebrand, in Meek, Field Mus. Nat. Hist. Pub., Zoöl. Ser., X, 1914, 119 (Gorgona, Panama Canal Zone; and Zent and Parismina, Costa Rica).

Head 4.4 to 5.0; depth 6.1 to 6.9; D. III or IV-I, 7 to 9; A. I, 20 to 23; scales 42 to 44.

Body very elongate; belly moderately compressed, but not forming an edge; head as wide as deep; interorbital space 3.1 to 3.4 in length of head; snout rather pointed, 3.15 to 3.6 in head; eye 2.65 to 2.95; lower jaw included; mouth rather small, moderately oblique; no marked angle

FIG. 1. MENIDIA CHAGRESI (Meek & Hildebrand).
From the type 90 mm. in length.

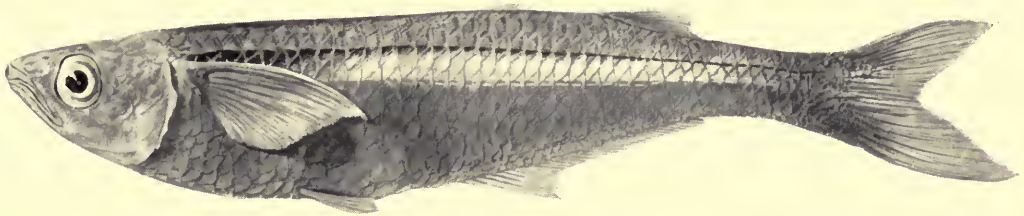

FIG. 2. MENIDIA STARKSI sp. nov.
From a paratype 142 mm. in length.

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of articulation of mandible; gill-rakers very short, less than a fourth the length of eye, about 18 on the lower limb of first arch; teeth in the jaws in villiform bands, the outer series in upper jaw enlarged, situated on outer edge of jaw; scales mostly smooth, occasionally a few in front of dorsal, on median line of back, slightly crenate; dorsals and anal without scales; first dorsal inserted over about the fifth ray of anal, slightly nearer margin of opercle than base of caudal; pectoral fins longer than head, reaching almost as far back as the short ventrals, 4.1 to 4.55 in length of body.

Color greenish above, paler below; sides with a conspicuous bluish black band which occupies the fourth row of scales and is scarcely as wide as the pupil; back and snout with dusky punctulations; median line of back with a dark streak; base of anal with dusky points which are continued to base of caudal.

This species is represented by 117 specimens ranging from 25 to 115 mm. in length. All the specimens are from fresh or brackish water of the Atlantic slope as follows: small creek at Mindi; Rio Trinidad, Agua Clara; Rio Gatun, Monte Liria; Rio Chagres, Gorgona; Rio Gatunocello, Alhajuela; Rio Boqueron; Rio Indio, a branch of the Upper Chagres; Rio Cascajal, Porto Bello. Also known from Costa Rico.

202. Menidia starksi sp. nov. (Plate XX, fig. 2.)

Type No. 79732, U. S. N. M.; length 235 mm.; Taboga Island, Panama.

Head 4.4 to 4.75; depth 4.3 to 4.8; D. III or IV-I, 7 or 8; A. 1, 24 to 28; scales 39 or 40.

Body elongate, compressed; the belly round in section, not compressed into an edge or keel; head notably deeper than wide; interorbital space 2.7 to 2.9 in length of head; snout pointed, projecting beyond lower jaw, about equal to length of eye, 2.9 to 3.3 in head; eye 3 to 3.3; mouth of moderate size, the gape curved; no marked angle at articulation of mandible; gill-rakers about half the length of eye, 13 to 15 on the lower limb of first arch; teeth present on both jaws, curved slightly backward; scales smooth, firm and adherent; first dorsal small, inserted over about the fourth ray of anal, about midway between upper anterior angle of opercle and base of caudal; last ray of second dorsal in advance of last ray of anal; anal fin long, with a wide sheath of scales at base; pectorals slightly longer than head, not reaching quite as far back as the short ventrals, 4.15 to 4.5 in body.

Color greenish above, pale below; sides with a well defined silvery band which has a bluish margin above, and which occupies the lower half of the third and the fourth row of scales, and is about three-fourths as wide as eye; snout and back everywhere with dusky punctulations; median line of back with a very narrow dark streak.

We have 9 specimens of this species, ranging in length from 95 to 140 mm. It seems to fall between two genera, *Menidia* and *Eurystole,* filling in the gap between them. The latter genus was based chiefly on the long anal fin (Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 802).

Our specimens are from Taboga Island, Panama.

80. Genus **Kirtlandia** Jordan & Evermann.

Kirtlandia Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 794 (type *Chirostoma vagrans* Goode & Bean).

This genus apparently differs from *Menidia* only in having the *scales crenate.* This may, however, yet prove to be of no generic value, as is indicated by the species described in this paper under the name *Menidia chagresi,* which occasionally has some of the scales on the back slightly crenate.

KEY TO THE SPECIES.

a. First dorsal wholly in front of origin of anal; pectorals short, scarcely as long as head, 5 to 5.6 in body. *gilberti,* p. 268.

aa. First dorsal inserted over the anterior half of base of anal; pectorals long, notably longer than head, 3.4 to 4.1 in body.

b. Body moderately deep, depth 4.7 to 5.4 in length; lateral band wide, about half the width of eye; scales 43 to 47. *pachylepis,* p. 269.

bb. Body very elongate, depth 5.7 to 6.2 in length; lateral band narrow, not as wide as pupil; scales 39 to 40. *beani* sp. nov., p. 270.

203. Kirtlandia gilberti (Jordan & Bollman).

Menidia gilberti Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 155 (Panama); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 798.

Kirtlandia gilberti Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 58 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 88 (Naos Island, Panama Bay).

Head 4.4 to 5.2; depth 5.7 to 6.4; D. IV or V-I, 9 or 10; A. I, 18 to 22; scales 49 to 54.

Body elongate, compressed; belly not forming an edge; head rather low and wide, its width slightly greater than its depth; interorbital space notably wider than eye, 2.65 to 3.1 in head; snout rather long and pointed, about as long as eye, 3 to 3.6 in head; eye 2.65 to 3.35; mouth small, the gape not reaching eye; lower jaw included; gill-rakers scarcely half the length of eye, about 22 on lower limb of first arch; teeth in jaws very small, none on vomer or palatines; scales mostly crenate; dorsal and anal scaleless; first dorsal wholly in front of anal, its origin somewhat nearer upper anterior angle of opercle than base of caudal; pectorals slightly shorter than head, reaching about to base of ventrals, 5.0 to 5.6 in length of body.

Color greenish above, pale silvery below; sides with a well defined silvery band which occupies the fourth row of scales, and is bounded by a dark blue streak above, width of band three-fourths that of the eye; scales on back everywhere dusted with brown dots; snout dusky; a narrow black line present on median line of back.

Over 300 specimens of this species were preserved. They range in length from 40 to 140 mm. This species was found on only two occasions and then in rather large numbers.

Known only from Panama Bay. Our specimens are from Chame Point and Taboga Island.

204. Kirtlandia pachylepis (Günther).

Atherinichthys pachylepis Günther, Proc. Zoöl. Soc. London, 1864, 25 (Panama).

Menidia pachylepis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 801.

Thyrina pachylepis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2840.

Kirtlandia pachylepis Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 57 (Panama Bay).

Head 4.5 to 5.3; depth 4.7 to 5.4; D. III to V-I, 7 to 9; A. I, 20 to 23; scales 43 to 47.

Body elongate, notably compressed; belly round; head rather flat above, its width not quite equal to its depth; interorbital space much wider than eye, 2.25 to 2.7 in length of head; snout rather blunt, shorter than eye, 3.3 to 3.65 in head; eye 2.5 to 3.1; mouth small and oblique, the gape not nearly reaching eye; lower jaw included; gill-rakers scarcely half the length of eye, about 22 on lower limb of

first arch; teeth in the jaws in bands, the outer series in upper jaw somewhat enlarged; scales crenate; base of anal with a row of scales; dorsal scaleless; first dorsal inserted over about the fourth ray of anal, somewhat nearer base of caudal than base of pectorals; pectorals notably longer than head, reaching well past the base of ventrals, frequently almost to their tips, 3.4 to 3.8 in length of body.

Back greenish, pale silvery below; sides with a well defined silvery band which is bounded above by a dark blue streak, and which occupies the third row of scales and is about half as wide as eye; scales on back sprinkled with brown points; snout dusky; a dark line present on median line of back.

About 130 specimens, ranging from 40 to 140 mm. in length, were preserved. This species was taken more frequently, but not in as large numbers, as *K. gilberti.*

Known from Panama Bay and Guayaquil, Ecuador. Our specimens are from Chame Point, Taboga Island, and Balboa.

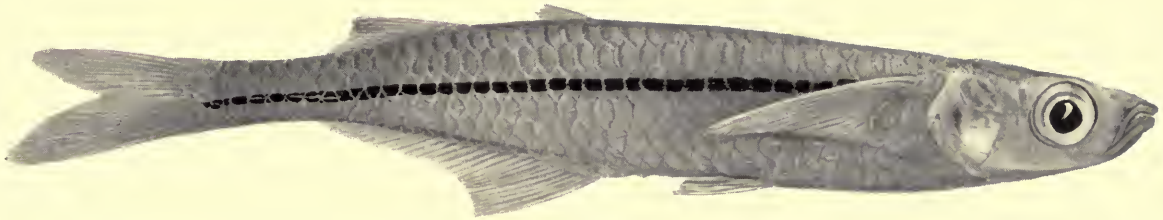
205. Kirtlandia beani sp. nov. (Plate XXI.)

Type No. 79741, U. S. N. M.; length 85 mm.; Fox Bay, Colon, Panama.

Head 4.3 to 4.7; depth 5.7 to 6.2; D. III or IV-I, 7 to 9; A. I, 19 to 22; scales 39 to 40.

Body elongate, moderately compressed; belly compressed, but not forming an edge; head quite as wide as deep; interorbital space 2.9 to 3.2 in length of head; snout wide, depressed, its length 2.8 to 3.25 in head; eye 2.8 to 3.25; lower jaw included; mouth small, very oblique; a marked angle at articulation of mandible; gill-rakers less than one-fourth the length of eye, about 19 on the lower limb of first arch; teeth in the jaws in villiform bands, the outer series in the upper jaw enlarged, situated on outer margin of jaw; scales moderately laciniate on the back, crenate on sides; dorsal and anal without scales; first dorsal inserted over about the sixth ray of anal, midway between upper anterior angle of opercle and base of caudal; pectorals longer than head, reaching nearly as far back as the short ventrals, 3.85 to 4.1 in length of body.

Color greenish above, paler below; sides with a conspicuous blackish band, which occupies the third row of scales and is only about three-fourths the width of pupil; back and sides everywhere with dusky punctulations, these most numerous on snout and back; median line of back with a dark streak; base of anal with dusky points, which are continued to base of caudal.



KIRTLANDIA BEANI sp. nov.
From a paratype 100 mm. in length.

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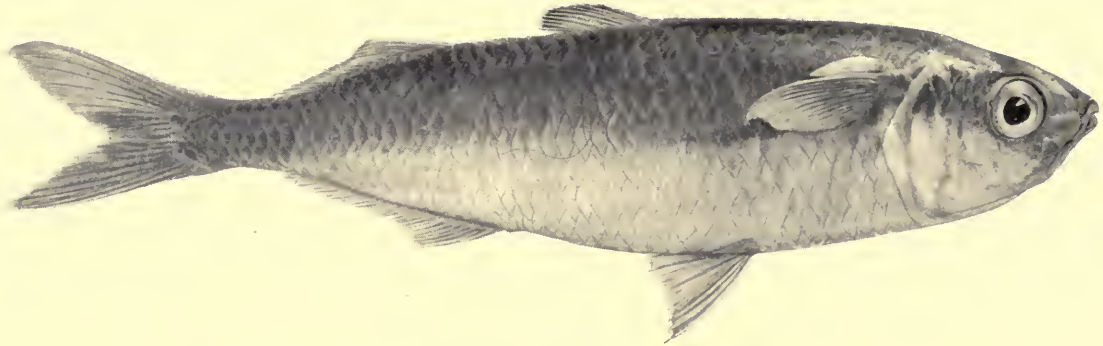

FIG. 1. MUGILOPS CYANELLUS gen. et sp. nov.
From the type 95 mm. in length.

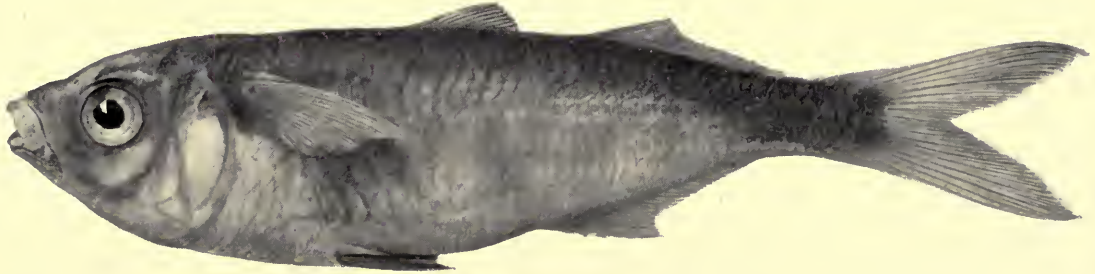

FIG. 2. MUGILOPS MARINUS sp. nov.
From the type 50 mm. in length.

We have 40 specimens of this species, ranging in length from 55 to 100 mm. It resembles *Menidia chagresi,* from which it is distinguished by the more pectinate scales, the more oblique mouth, the position of the lateral band and several other minor differences.

Our specimens are from Fox Bay, Colon. They were all taken on the same date (Mar. 31, 1911), after which this species did not again appear.

81. Genus **Mugilops** gen. nov.

Type *Mugilops cyanellus* sp. nov.

Body rather deep, compressed; mouth small, terminal; lower jaw included; premaxillaries protractile, strongly curved; the first dorsal long, with 7 to 9 spines; vertebræ about 40; lateral band wanting. This genus superficially resembles the mullets, but the spinous dorsal is longer and the spines are flexible; the intestinal canal is short and the body is deeper and more strongly compressed than in any of the species of mullets known to the writers.

KEY TO THE SPECIES.

a. First dorsal with 8 or 9 spines, inserted an eye's diameter nearer end of snout than base of caudal; body moderately elongate, the chest rounded, greatest depth 3.75 to 4 in length. *cyanellus* sp. nov., p. 271.

aa. First dorsal with 7 spines, inserted equidistant from end of snout and base of caudal; body deep, the chest compressed, greatest depth 3.7 in length. *marinus* sp. nov., p. 272.

206. Mugilops cyanellus sp. nov. (Plate XXII, fig. 1.)

Type No. 81748, U. S. N. M.; length 95 mm.; Balboa, Panama Bay.

Head 4.15 to 4.3; depth 3.75 to 4; D. VIII or IX-I, 15 to 17; A. I, 18 to 22; scales 43 to 47.

Body deep, compressed; dorsal and ventral outlines about evenly convex; chest rounded; head short and deep, the length not exceeding depth by more than half the diameter of eye; interorbital space 2.7 to 3 in length of head; snout short and rather blunt, its length 3.45 to 3.7; eye 2.95 to 3.2; mouth very small, the gape not reaching half the distance to eye; a marked angle at articulation of mandible; teeth small, present in jaws only, arranged in villiform bands, none of them especially enlarged; scales large, crenate on back, slightly crenate to smooth on sides and below; alimentary canal short, no pyloric cæca;

ovaries well distended with eggs (Two females examined, one of which was taken in March and the other in May); dorsal and anal each with a row of scales at base; first dorsal much in advance of anal, inserted about an eye's diameter nearer tip of snout than base of caudal; second dorsal inserted over about the sixth ray of anal; caudal forked, the lower lobe slightly the longer; pectorals placed high, very short, reaching a little past the base of the small ventrals, 5.3 to 5.6 in body.

Color dark blue above; lower half of sides and belly bright silvery; no trace of a lateral band; snout dusky; base of caudal with a rectangular blotch; peritoneum black.

Five examples of this species were taken, ranging in length from 70 to 95 mm. The species resembles the mullets in general appearance.

Our specimens are from Taboga Island and Balboa.

207. Mugilops marinus sp. nov. (Plate XXII, fig. 2.)

Type No. 81742, U. S. N. M.; length 50 mm.; Porto Bello, Panama.

Head 3.7; depth 3.7; D. VII-I, 16; A. I, 20; scales 42.

Body deep, rather strongly compressed; the ventral outline a little more strongly curved than the dorsal; chest compressed; head short and deep, the length exceeding the depth by a little less than the diameter of the eye; interorbital space 3.1 in head; snout short, its length 4 in head; eye 3.35; mouth very small, the gape reaching less than half the distance to the eye; no marked angle at articulation of mandible; teeth very small, in a very narrow band in lower jaw, mostly in a single irregular series in upper jaw; scales moderate, cycloid, partly lost in the specimen in hand; lateral line represented by 10 to 12 pores on scales above pectoral; second dorsal and anal each with a row of scales at base; first dorsal wholly in advance of anal, inserted about equidistant from end of snout and base of caudal; origin of second dorsal over anterior third of anal; caudal fin forked, the lower lobe the longer; pectoral fins placed high, reaching well past the base of the small ventrals, 5.3 in body.

Color bluish black above, silvery on sides and below; lateral band wanting; base of caudal with a rectangular dark blotch.

We have a single specimen, 50 mm. in length, taken at Porto Bello. It appears to differ from the Pacific coast form in having the body somewhat deeper and more strongly compressed, especially the chest and abdomen. The first dorsal has fewer spines by one and it appears to be slightly more anteriorly inserted. Our material is, however, insufficient to establish the true relationship.

Family XXXVI. Mugilidæ.

The Mullets.

Body oblong, more or less compressed; mouth small, the jaws with small teeth or none; the teeth various in form; premaxillaries protractile; gill-openings wide, the membranes separate, free from the isthmus; gills 4, a slit behind the fourth; gill-rakers long and slender; pseudobranchiæ large; branchiostegals 5 or 6; scales large; no lateral line, but the scales with furrows forming lateral streaks; air bladder large; intestinal canal long; peritoneum usually black; two short dorsal fins, well separated, the anterior with 4 stiff spines, the last spine much shorter than the others; second dorsal longer than the first, similar to the anal; anal with 2 or 3 graduated spines; ventral fins abdominal, composed of one spine and 5 soft rays; caudal fin forked. Only two genera are represented among the marine species in the Panama collection. The fresh water species belonging to the genera, *Agonostomus* and *Joturus*, are discussed in "The Fishes of the Fresh Waters of Panama" by Meek & Hildebrand (Field Museum of Natural History Publication, Zoölogical Series, Vol. X, 1916, pp. 332 to 338).

KEY TO THE GENERA.

a. Cleft of mouth chiefly transverse; the lips thin; teeth small, ciliiform, in one or a few series in each jaw; adipose eyelid well developed in adult. *Mugil*, p. 273.

aa. Cleft of mouth lateral; the upper lip thick; teeth small, ciliiform, in many series in each jaw; adipose eyelid wanting at all ages. *Chænomugil*, p. 281.

82. Genus **Mugil** Linnæus.

Mugil Linnæus, Syst. Nat., Ed. X, 1758, 316 (type *Mugil cephalus* Linnæus).

Querimana Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 588 (type *Myxus harengus* Günther; young).

Body elongate, somewhat compressed; head rather large, usually about as wide as deep, scaled above and on sides; eye, in adult, with a strongly developed adipose membrane, small or wanting in young; mouth subinferior, oblique, the gape wide, but not deep; lower jaw angulated; jaws with one or a few series of small, flexible, ciliiform teeth; no teeth on vomer or palatines; anal fin in very young with 2

spines, adult constantly with 3 spines; the first soft ray having been transformed into a spine; stomach with heavy muscular walls. Mud eating fishes, abundant in many warm, shallow bays, where they often give great leaps above the surface of the water.

KEY TO THE SPECIES.

a. Soft dorsal and anal naked at all ages; anal rays III, 8; rows of scales along sides with dark streaks.

b. Scales large, 31 to 36 in a lateral series; head low and wide, its greatest width exceeding the depth; cleft of mouth much wider than deep. *brasiliensis*, p. 274.

bb. Scales smaller, 37 to 41 in a lateral series; head higher, its height exceeding its width; cleft of mouth only slightly wider than deep. *cephalus*, p. 275.

aa. Soft dorsal and anal densely scaled in adult, with few or no scales in very young; anal rays III, 9, except in *M. trichodon*, which has III, 8.

c. Teeth in the jaws in a single series; fins not deeply falcate.

d. Scales very large, 29 to 31 in a lateral series; cleft of mouth nearly twice as wide as deep; anal rays III, 8. *trichodon*, p. 276.

dd. Scales smaller, 33 or more in a lateral series; cleft of mouth narrower, its width not greatly exceeding its depth; anal rays III, 9.

e. First dorsal inserted notably nearer the tip of snout than base of caudal; cleft of mouth as wide as deep; scales small, 42 to 47. *incilis*, p. 277.

ee. First dorsal usually inserted midway between the tip of snout and base of caudal, occasionally slightly behind this point; cleft of mouth wider than deep.

f. Upper lip thick; scales 43 to 45. *thoburni*, p. 278.

ff. Upper lip thin; scales 33 to 41. *curema*, p. 279.

cc. Teeth large, those in the upper jaw in several series; fins deeply falcate. *setosus*, p. 280.

208. Mugil brasiliensis Agassiz.

Mugil brasiliensis Agassiz, in Spix, Pisc. Brasil., 1831, 234, Pl. LXXII (Atlantic Ocean off Brazil); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 810.

Mugil liza Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 1836, 83 (Brazil, Porto Rico, Maracaibo, Surinam, Martinique).

Mugil lebranchus Poey, Memorias, II, 1861, 260, Pl. XVIII, fig. 3 (Cuba).

Head 3.7 to 4.0; depth 4.0 to 4.8; D. IV-I, 8; A. III, 8; scales 31 to 36.

Body elongate, slender, compressed; dorsal profile anteriorly straight; ventral outline convex; head depressed, wider than deep; interorbital space wide and flat, 2.15 to 2.65 in head; snout short and wide, 4.1 to 5.3 in head; eye 3.75 to 4.8; mouth oblique, subinferior, the gape much broader than long; gill-rakers of moderate length, slender, about 45 on first arch, including rudiments; pseudobranchiæ well developed; teeth in the jaws minute; scales very large, with finely serrated edges, except those on head which are smooth; fins with very few scales; origin of spinous dorsal slightly nearer tip of snout than base of caudal, its spines strong; second dorsal and anal inserted opposite each other; pectorals rather short, 1.35 to 1.45 in head.

Color bluish black above, silvery below; rows of scales on sides with distinct dark streaks; ventrals usually pale, other fins more or less dusky; peritoneum black.

This species is represented by 24 specimens in the present collection, ranging in length from 120 to 340 mm.

Known from the West Indies, southward to Brazil. Our specimens are from the French Diversion, New Gatun; Mindi Cut; and Fox Bay, Colon.

209. Mugil cephalus Linnæus.

Mugil cephalus Linnæus, Syst. Nat., Ed. X, 1758, 316 (Europe; based on Artedi); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 811, Pl. CXXVI, fig. 343.

Mugil albula Linnæus, Syst. Nat., Ed. XII, 1766, 520 (Charleston).

Mugil tang Bloch, Ichthyol., VIII, 1794, Pl. CCCXCV (Africa).

Mugil plumieri Bloch, Ichthyol., VIII, 1794, Pl. CCCXCVI (St. Vincent; on a drawing by Plumier).

Mugil lineatus Mitchill, MS., in Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 1836, 96 (New York).

Mugil rammelsbergii Tschudi, Fauna Peruana, Ichth., 1846, 20 (Peru).

Mugil berlandieri Girard, U. S. & Mex. Bound. Surv., Fishes, 1859, 20, Pl. X, figs. 1 to 4 (St. Josephs Id., Indianola; Brazos Santiago; Brazos; and Galveston).

Mugil güntheri Gill, Proc. Ac. Nat. Sci. Phila., 1863, 169 (western coast of Central America; not of Steindachner).

Mugil mexicanus Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII)

Ichth. Beitr., III, 1875, 58, Pl. VIII (Acapulco).

Head 3.4 to 4.2; depth 3.4 to 4.2; D. IV-I, 8; A. III, 8 (very young II, 9); scales 37 to 41.

Body rather robust, compressed, the ventral outline slightly more convex than the dorsal; head low, only slightly deeper than wide; interorbital space slightly convex, 2.4 to 3.3 in length of head; snout short, and of moderate width, its length 4.35 to 5.3 in head; eye 3.2 to 4.3; mouth oblique, the gape only slightly wider than deep; adipose eyelid strongly developed in adult, almost wholly wanting in young; gill-rakers numerous, slender and close set; pseudobranchiæ large; teeth in the jaws minute, but visible without the aid of lens; scales of moderate size, with a finely serrate membranous border, those on head striate; soft dorsal and anal without scales; origin of spinous dorsal about midway between tip of snout and base of caudal; soft dorsal inserted slightly behind origin of anal; pectorals not reaching origin of first dorsal, 1.25 to 1.45 in head.

Color bluish gray above, silvery below, with dark streaks along the rows of scales; ventrals and anal pale, other fins with more or less dusky; axil bluish black.

No specimens of this widely distributed species were obtained on either coast of Panama. The above description is based on specimens in the U. S. National Museum collection from Long Island, N. Y.; Beaufort, N. C.; Hawaii, and Japan.

Known from nearly all the warmer shores of both hemispheres. On the Atlantic coast of America from Cape Cod to Brazil, on the Pacific coast from Monterey to Chile. Recorded from Panama Bay by Jordan (Proc. U. S. Nat. Mus., 1885, 371); not seen by other investigators.

210. Mugil trichodon Poey.

Mugil trichodon Poey, Ann. Lyc. Nat. Hist. N. Y., XI, 1875, 66, Pl. VIII, figs. 4 to 8 (Cuba); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 816.

Querimana gyrans Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 26 (Key West).

Mugil brasiliensis Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 270 (not of Agassiz).

Head 3.3 to 4.0; depth 3.2 to 3.6; D. IV-I, 7; A. III, 8; scales 29 to 31.

Body robust, the dorsal profile anteriorly straight; ventral outline gently curved; head not quite as wide as deep, the interorbital space

slightly convex, 2.1 to 2.8 in head; snout short and blunt, its length 4.2 to 5 in head; eye 3.1 to 3.95; the mouth oblique, subinferior, the gape short and wide, about twice as wide as deep; adipose eyelid in large examples very strongly developed, making it difficult to measure eye; gill-rakers scarcely half length of eye, about 70 in number; pseudobranchiæ rather small; teeth in the jaws movable, notably larger than in related species; each scale very large, with very finely serrate membranous edges, those on head striate, without membranous edges; soft dorsal and anal thickened by scales; origin of spinous dorsal midway between tip of snout and base of caudal, the spines strong; second dorsal inserted slightly behind origin of anal, in our specimens with only 7 soft rays (not 8, as given in current descriptions); pectorals rather short, 1.3 to 1.4 in head.

Color bluish above, silvery below; no dark streaks along the rows of scales; ventrals and anal pale, other fins usually with more or less dusky; base of pectorals bluish; peritoneum jet black.

Present collection contains 9 specimens, ranging in length from 95 to 250 mm.

Known from the south Atlantic States, southward to Brazil. Our specimens are from Fox Bay, Colon; and Colon market.

211. Mugil incilis Hancock.

Mugil incilis Hancock, Quart. Journ. Sci., 1830, 127 (Guiana); Günther, Trans. Zoöl. Soc. London, VI, 1868, 443; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 812; Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2 (Colon, Panama).

Mugil güntheri Steindachner, (Sitzb. k. Ak. Wiss. Wien, XLIX) Ichth. Notizen, I, 1864, 12 (British Guiana).

Head 3.3 to 4.4; depth 3.6 to 4.55; D. IV-I, 8; A. III, 9 (very young II, 10); scales 42 to 47.

Body slender, average depth, of 22 specimens measured, 4.24 in length; dorsal profile anteriorly only very slightly convex; ventral profile more strongly curved than the dorsal; head rather low, its greatest width equal to its greatest depth, interorbital space convex, 2.35 to 3.2 in length of head; snout short and rather narrow, its length 4.25 to 5.5 in head; eye 3.2 to 4.15; the mouth oblique, nearly terminal, the gape as wide as deep; adipose eyelid strongly developed in adult, almost wholly wanting in young; gill-rakers close set, numerous, 70 in number in a specimen 215 mm. long, apparently increasing in number with age; pseudobranchiæ large; teeth in the jaw minute, visible only with the aid of the lens; scales small, with finely serrated edges,

except those on head which are smooth; soft dorsal and anal covered with scales, but not especially thickened by them; origin of spinous dorsal notably nearer tip of snout than base of caudal, the spines strong; origin of second dorsal behind that of anal; pectorals of moderate length, not quite reaching origin of first dorsal, 1.2 to 1.5 in head.

Color bluish black above, silvery below; rows of scales without dark streaks; ventrals and anal pale; other fins more or less dusky; axil black; peritoneum dusky.

Of this species 120 specimens are contained in the present collection, ranging in length from 45 to 380 mm. The very young, of 55 mm. and less in length, have only 2 anal spines, but 10 soft rays. From specimens at hand it is evident that the first soft ray which is never divided, develops into a spine when the fish reaches a length of about 60 mm.

Known from the Atlantic coast of Panama southward to Brazil. Our specimens are from Toro Point; Fox Bay, Colon; Mindi Cut; and French Diversion, New Gatun.

212. Mugil thoburni Jordan & Starks.

Mugil incilis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 624 (not of Hancock; Panama City).

Mugil thoburni Jordan & Starks, in Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 812 (Galapagos); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 59 (Panama Bay).

Head 3.5 to 3.8; depth 3.7 to 3.8; D. IV-I, 8; A. III, 9; scales 43 to 45.

Body moderately elongate, compressed, the ventral outline more convex than the dorsal; head slightly deeper than wide, the interorbital space convex, 2.5 to 2.7 in length of head; snout rather long and narrow, 3.9 to 4.2 in head; eye 3.5 to 4.7; mouth oblique, the gape wider than deep; upper lip thicker than in closely related species; adipose eyelid greatly developed in adult; gill-rakers numerous, slender, close set; pseudobranchiæ large; teeth in the jaws minute, but visible without the aid of a lens; scales small, with a finely serrate membranous border, those on head striate; soft dorsal and anal scaly; first dorsal inserted slightly behind a point midway between the tip of snout and base of caudal; origin of second dorsal slightly behind that of anal; pectorals reaching nearly to origin of first dorsal, 1.3 to 1.4 in head.

Color bluish gray above, silvery below; no dark streaks along the rows of scales; ventrals pale; other fins with more or less dusky.

This species was not taken by us. The above description is based on the two type specimens, 140 and 150 mm. long, and a larger specimen, 295 mm. long, collected at the Galapagos Islands. It differs from the closely related species, *M. curema,* in having more scales in a lateral series, and in the much thicker upper lip.

Known from Guatemala to the Galapagos Islands. Recorded from Panama by Jordan & Gilbert (as *M. incilis*), Proc. U. S. Nat. Mus., 1882, 624.

213. Mugil curema Cuvier & Valenciennes.

Mugil curema Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 1836, 87 (Brazil; Martinique; Cuba); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 813, Pl. CXXVI, fig. 344; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 60 (Panama Bay).

Mugil petrosus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 1836, 89 (Brazil; Surinam; Gulf of Mexico; Cuba).

Mugil brasiliensis Günther, Cat. Fish. Brit. Mus., III, 1861, 431 (not of Agassiz); Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 403 (not of Agassiz).

Myxus harengus Günther, Cat. Fish. Brit. Mus., III, 1861, 467 (Pacific Coast of Central America).

Mugil gaimardianus Desmarest, Dict. Class., 1831, Pl. CIX (Cuba; no description); Poey, Ann. Lyc. Nat. Hist. N. Y., XI, 1875, 64, Pl. VII, figs. 1-3 (Cuba; first description).

Querimana harengus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 588 (Part); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 62 (Panama Bay).

Mugil hospes Jordan & Culver, Proc. Cal. Ac. Sci., 1895, 422, Pl. XXXI (Mazatlan); Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 2; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 60 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 88 (Lat. 16° 47′ N.; Long. 100° 27′ W.).

Head 3.1 to 4.2; depth 3.2 to 4.45; D. IV-I, 8; A. III, 9 (very young II, 10); scales 33 to 41.

Body rather slender, somewhat compressed, ventral outline usually more strongly curved than the dorsal; head rather low, only slightly compressed, its greatest depth exceeding the width; interorbital space convex, 2.2 to 3.4 in length of head; snout short and rather wide, its length 4 to 5.4 in head; eye 2.9 to 4.5; mouth subinferior, oblique,

the gape notably wider than deep; adipose eyelid well developed in adult, almost wholly wanting in young; gill-rakers close set, numerous, about 65 in number in adult; pseudobranchiæ large; teeth in the jaws minute, but usually visible without the aid of a lens, proportionately larger in young; scales rather large, with finely serrate membranous edges, those on head striate, without serrate membranous edges; soft dorsal and anal scaly in adult, the young, of less than 80 mm. in length, with few or no scales; origin of first dorsal midway between tip of snout and base of caudal, slightly back of this point in young; origin of soft dorsal slightly behind that of anal; pectorals of moderate length, usually not quite reaching origin of first dorsal, occasionally reaching to or slightly past it, 1.2 to 1.7 in head.

Color bluish above, silvery below; no evident dark streaks along the rows of scales; ventrals and anal usually pale, other fins with more or less dusky; axil bluish black; peritoneum jet black.

Of this species we have 54 specimens from the Atlantic coast, ranging from 40 to 360 mm. in length, and 314 from the Pacific coast, which range from 20 to 385 mm. in length. We have carefully compared our large series from the two coasts, and are unable to detect any constant differences. We have examined the cotype of *M. hospes*, and several specimens of *M. gaimardianus* from Cuba supposed to be of Poey's own identification. Our large series indicate that these nominal species are not distinct, but are merely a variety with the pectoral fins somewhat longer than is usual in *M. curema*. In the young the pectoral fins nearly always reach the origin of first dorsal, and occasionally this is true of an adult specimen.

Known from both coasts of America, from Cape Cod to Brazil and the Gulf of California to Chile. Also recorded from West Africa. Our Atlantic specimens are from Toro Point; Fox Bay, Colon; Colon Reef; Colon market; Mindi Cut; French Diversion, New Gatun; and Porto Bello. Pacific specimens are from Chame Point; Taboga Island; Naos Island; Panama Bay; tide streams, and tide pools, Balboa; tide streams, Corozal; Panama market, and tide pools, Panama.

214. Mugil setosus Gilbert.

Mugil setosus Gilbert, Proc. U. S. Nat. Mus., 1891, 549 (Clarion Island); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 815 (Mazatlan and Clarion Island).

Head 3.3 to 3.75; depth 3.6 to 4.25; D. IV-I, 8; A. III, 9; scales 35 to 38.

Body compressed, the ventral outline more convex than the dorsal; head rather large, notably deeper than wide; interorbital space convex, 2.6 to 3.0 in length of head; snout rather narrow, 4.1 to 5.1 in head; eye 3.55 to 3.9; mouth oblique, the gape about as deep as wide; the upper lip thick; adipose eyelid well developed in adult; gill-rakers numerous, and close set; pseudobranchiæ well developed; teeth in the jaws larger than in related species, those in the upper jaw in more than one series; scales rather large, more or less striate, with an almost smooth membranous border, those on head without membranous border; soft dorsal and anal scaly; the spinous dorsal inserted slightly nearer base of caudal than tip of snout; insertion of soft dorsal slightly behind that of anal, both fins higher than in other species of the genus; caudal fin deeply forked, the lobes much longer than head; pectorals not quite reaching origin of first dorsal, 1.3 to 1.4 in length of head.

Color plain grayish above, silvery below; no dark streaks along the row of scales; ventrals pale, other fins more or less dusky; caudal fin with a black margin; peritoneum black.

Here redescribed from the 4 type specimens from Clarion Island, ranging in length from 150 to 265 mm.

Known from the Revillagigedo Islands and Mazatlan, not recorded from Panama.

83. Genus **Chænomugil** Gill.

Chænomugil Gill, Proc. Ac. Nat. Sci. Phila., 1863, 169, (type *Mugil proboscideus* Günther).

Cleft of mouth lateral; the upper lip very thick; small ciliiform teeth in many series in each jaw; adipose eyelid wanting at all ages.

215. **Chænomugil proboscideus** (Günther).

Mugil proboscideus Günther, Cat. Fish. Brit. Mus., III, 1861, 459 (Island of Cordova, west coast of Central America).

Chænomugil proboscideus Gill, Proc. Ac. Nat. Sci. Phila., 1863, 169; Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 272; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 61 (Panama Bay); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 88 (Acapulco, Culebra Island and Chatham Island).

Head 3.4 to 4.0; depth 3.1 to 3.4; D. IV-I, 8; A. III, 10; scales 37 to 42.

Body compressed; the dorsal profile little convex; ventral outline strongly curved; head compressed, interorbital space convex, 2.1 to 2.4 in head; snout rather pointed, usually slightly longer than eye, 2.9 to 3.5 in head; eye 3.3 to 3.8; mouth oblique, rather narrow, the cleft notably longer than broad; upper jaw projecting, premaxillaries very protractile; maxillary reaching anterior margin of eye, the upper lip thick; gill-rakers of moderate length, slender, about 23 on the lower limb of the first arch; pseudobranchiæ well developed; external edges of both jaws with a band of very weak, movable teeth; scales large, their edges finely serrate; dorsal fins, caudal and anal with scales between the rays; first dorsal small, with strong spines, inserted about midway between anterior margin of eye and base of caudal; second dorsal over the posterior two-thirds of anal base, its outer margin concave; anal fin shaped like the second dorsal, but longer; pectorals rather long, 1.05 to 1.2 in head.

Color bluish black above, silvery below; rows of scales on sides with more or less distinct dark lines; ventrals pale; other fins all more or less dusky; peritoneum black.

This species is represented by 79 specimens, ranging in length from 45 to 220 mm.

Known from Mazatlan southward to Panama Bay. Our material is from Taboga Island, Balboa, and Panama market. The species is common in tide pools.

Family XXXVII. Sphyrænidæ.

The Barracudas.

Body very elongate, little compressed; head very long, pointed, pike-like; mouth nearly horizontal, large; jaws elongate, the lower strongly projecting, the upper not protractile, its border formed by the premaxillaries, behind which are the broad maxillaries; jaws and palatines with large, sharp teeth of unequal size; no teeth on vomer; usually a very strong, sharp canine near the tip of the lower jaw; opercular bones without spines or serrations; gill-membranes separate, free from the isthmus; gill-rakers very short or obsolete; branchiostegals 7; gills 4, a slit behind the fourth; pseudobranchiæ well developed; air bladder large, bifurcate anteriorly; pyloric cæca numerous; scales small, cycloid, present on cheeks and opercles, usually few on upper surface of head; lateral line well developed, straight, first dorsal with 5 spines, second dorsal remote from the first, similar to and

opposite the anal; caudal fin forked; ventral fins 1, 5, abdominal, in advance of middle of body; pectoral fins short, placed in or below the axis of the body; vertebræ 24. This family is composed of a single genus.

84. Genus **Sphyræna** Klein.

Sphyræna Klein, Neuer Schauplatz, etc., VI, 1778, 464 (type *Esox sphyræna* Linnæus); Röse, Artedi Syn. Nom. Pisc., Ed. II, 1793, 112 (type=*Esox sphyræna* Linnæus); Bloch & Schneider, Syst. Ichth., 1801, 109 (type *Esox sphyræna* Linnæus).

The characters of the genus are included in the family description.

KEY TO THE SPECIES.

a. Ventral fins inserted in advance of the spinous dorsal, about midway between tip of lower jaw and base of last anal ray; pectoral fins reaching beyond base of ventrals, and beyond origin of spinous dorsal; maxillary reaching to or slightly past anterior margin of orbit in adult.

b. Scales large, 79 to 85 in a lateral series. *barracuda*, p. 283.

bb. Scales smaller, 108 to 130 in a lateral series.

c. Scales 108 to 116; sides with about 20 dark bars, extending from back to slightly below lateral line. *ensis*, p. 285.

cc. Scales smaller, 118 to 130; no dark bars; very young (75 mm.) with broad jet black rings encircling the body. *guachancho*, p. 285.

aa. Ventral fins inserted directly under the origin of spinous dorsal, much nearer base of last anal ray than tip of lower jaw; pectorals failing to reach base of ventrals or origin of spinous dorsal; maxillary never reaching anterior margin of orbit.

d. Eye small, 5.3 to 5.7 in head; interorbital area rather strongly convex. *borealis*, p. 286.

dd. Eye large, 4.85 to 5.0 in head; interorbital area flattish. *picudilla*, p. 287.

216. Sphyræna barracuda (Walbaum).

Esox barracuda Walbaum, Artedi Piscium, III, 1792, 94 (after Catesby).

Sphyræna sphyræna var. *picuda* Bloch & Schneider, Syst. Ichth., 1801, 110 (after Parra).

Sphyræna becuna Lacépède, Hist. Nat. Poiss., V, 1803, 321, Pl. IX, fig. 3 (from a drawing by Plumier made at Martinique).

Sphyræna picuda Günther, Cat. Fish. Brit. Mus., II, 1860, 336; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 412; Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 68; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 823.

Sphyræna barracuda Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1898, 2841, Pl. CXXVIII, fig. 349.

Head 2.95 to 3.35; depth 6.15 to 7.2; D. V-I, 8 or 9; A. II, 8 or 9; scales 79 to 85.

Body very elongate, moderately compressed; head long and low, a little deeper than wide, flat above; interorbital area transversely slightly concave, with low ridges; snout long and pointed, 2.1 to 2.3 in head; eye 4.9 to 7.2; mouth large, slightly oblique; lower jaw strongly projecting, ending in a conical point; maxillary large, reaching well past anterior margin of eye, longer than snout in adult, proportionately shorter in young, failing to reach anterior margin of eye and shorter than snout in very young, 1.9 to 2.3 in head; teeth rather large, moderately compressed; gill-rakers obsolete; scales moderate; cheeks and opercles scaly; scales on cheeks notably reduced in size; upper surface of head mostly naked; dorsal fins far apart, the first with 5 slender spines, the second spine the longest, 2.6 to 3.7 in head; second dorsal and anal similar, placed opposite each other, both moderately elevated anteriorly; caudal fin forked, the lower lobe the longer; ventral fins as long as the pectorals, inserted in advance of spinous dorsal about midway between tip of lower jaw and base of last anal ray; pectoral fins reaching well past base of ventrals, also slightly past origin of first dorsal, 2.5 to 3.2 in head.

Color grayish brown above, silvery below; young with dark crossbars on back and quadrate blotches on sides, all of which disappear with age; sides with conspicuous inky spots, irregularly placed; soft dorsal, anal, caudal and ventrals black, with white margin and tips; pectorals nearly plain translucent; fins with less black in young, mostly pale in very young.

This species is represented by 54 specimens, ranging from 55 to 820 mm. in length.

Known from South Carolina southward to Brazil, occasionally straying northward to Woods Hole, Massachusetts. Our specimens are from Toro Point; Mindi Cut; Colon Reef; Fox Bay, Colon; Colon market and Porto Bello.

217. Sphyræna ensis Jordan & Gilbert.

Sphyræna fosteri Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXVIII) Ichth. Beitr., VII, 1878, 4 (not of Cuvier and Valenciennes).

Sphyræna ensis Jordan & Gilbert, Bull. U. S. Fish. Comm., II, 1882 (1883), 106 (Mazatlan), and 109 (Panama), and Proc. U. S. Nat. Mus., 1882, 624; Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 70; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 824; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 62.

Head 3.27 to 3.8; depth 6.8 to 9.25; D. V. I, 9 or 10; A. II, 7 or 8; scales 108 to 116.

Body very elongate, little compressed; head long and low, its depth only slightly greater than its width, its upper surface flat; interorbital area slightly convex, with rather prominent ridges; snout long and pointed, 1.9 to 2.2 in head; eye 4.34 to 5.7; mouth large, slightly oblique; lower jaw strongly projecting, ending in a conical point; maxillary large, reaching anterior margin of eye in adult, not reaching eye in young, 1.8 to 2.2 in head; teeth very large, strongly compressed; gill-rakers very small and short; scales rather small; cheeks and opercles scaly; scales on cheeks reduced in size; upper surface of head mostly naked; dorsal fins far apart, the first one with 5 slender spines, the second spine the longest, 2.6 to 3.2 in head; second dorsal and anal similar, both moderately elevated anteriorly, placed opposite each other; caudal fin forked, the lower lobe slightly the longer; ventral fins a little shorter than pectorals, inserted in advance of origin of spinous dorsal, about midway between tip of lower jaw and base of last anal ray; pectoral fins reaching well past base of ventrals and to or slightly past the vertical from origin of spinous dorsal, 2.26 to 2.7 in head.

Color brownish above, silvery below; sides with about 20 indistinct dark bars from back downward to slightly below lateral line, running downward and slightly forward; ventral fins usually pale; all the other fins with more or less dusky.

We have only 6 specimens of this species, ranging from 105 to 470 mm. in length.

Known from the Gulf of California to Panama Bay. Our specimens are from Chame Point, Balboa and the Panama market.

218. Sphyræna guachancho Cuvier & Valenciennes.

Sphyræna guachancho Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829, 342 (Havana); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 824.

Sphyræna Guaguanche Poey, Memorias, II, 1860, 166.
Sphyræna güntheri Haly, Ann. & Mag. Nat. Hist., Ser. 4, XV, 1875, 270 (Colon).
Sphyræna guaguancho Goode & Bean, Proc. U. S. Nat. Mus., 1879, 146; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 411.
Sphyræna guaguanche Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 70.

Head 3.0 to 3.2; depth 6.1 to 7.65; D. V-I, 9; A. II, 7 or 8; scales 118 to 130.

Body very elongate, little compressed; head long and low, flat above; interorbital area slightly convex, with prominent ridges; snout long and pointed, 2.2 to 2.4 in head; eye 4.8 to 5.7; mouth large, little oblique; lower jaw strongly projecting, ending in a sharp conical point; maxillary large, reaching anterior margin of eye in adult, proportionately shorter in young, in which it fails to reach anterior margin of eye, 2.16 to 2.4 in head; teeth large, strongly compressed; gill-rakers obsolete; scales small; cheeks and most of opercles scaly; scales on cheeks not notably reduced in size; upper surface of head mostly naked; dorsal fins far apart, the first with 5 slender spines, the second spine the longest, 2.7 to 3.4 in head; second dorsal and anal similar, both anteriorly moderately elevated; origin of the dorsal slightly in advance of that of anal; caudal fin forked, the lower lobe the longer; ventral fins slightly shorter than the pectorals, inserted in advance of origin of spinous dorsal about midway between tip of lower jaw and base of last anal ray; pectoral fins reaching well past the base of the ventrals, also to or slightly past the vertical from origin of spinous dorsal, 2.5 to 2.9 in head.

Color grayish above, silvery below; upper surface of head dark; inky spots present; very young with black bands; dorsal fins and caudal dusky; other fins mostly pale.

This species is represented by 8 specimens, ranging from 50 to 260 mm. in length.

Known from Florida southward to Panama, occasionally straying northward in the Gulf Stream, as far as Woods Hole, Massachusetts. Our specimens are from Mindi Cut, Colon market and Porto Bello.

219. Sphyræna borealis De Kay.

Sphyræna borealis De Kay, Fauna N. Y., Fishes, 1842, 39, Pl. LX, fig. 196 (New York); Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 73; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 825.

Sphyræna spet Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 411 (not of Haüy).

Head 3.1 to 3.3; depth 7.8 to 10.0; D. V-I, 8 or 9; A. II, 8 or 9; scales 132 to 135.

Body very elongate, slender, little compressed; head long and low, considerably deeper than broad, its upper surface little convex; interorbital area convex, with rather prominent ridges; snout long and pointed, 2.2 to 2.4 in head; eye 5.3 to 5.7; mouth moderate, slightly oblique; lower jaw strongly projecting, ending in a conical point; maxillary moderate, failing notably to reach anterior margin of eye, 2.5 to 2.66 in head; teeth moderate, compressed; gill-rakers obsolete; scales very small; scales on cheeks not notably reduced in size; upper surface of head mostly naked; dorsal fins well separated, the first with 5 slender spines, the second spine the longest, 3.0 to 3.35 in head; second dorsal and anal similar and placed opposite each other, both anteriorly moderately elevated; caudal fin deeply forked, the lobes of about equal length; ventral fins a little shorter than the pectorals, inserted directly under the origin of the dorsal, much nearer the base of last anal ray than tip of lower jaw; pectoral fins failing notably to reach the base of ventrals, also failing to reach vertical from origin of spinous dorsal, 2.6 to 3.1 in head.

Color grayish brown above, silvery below; a dark longitudinal stripe from snout through eye, along lateral line to base of caudal; this stripe more or less broken up into blotches in some of our specimens; upper surface of head and snout black; dorsal fins and caudal dusky; other fins mostly pale.

Of this species we have 12 specimens, ranging in length from 165 to 175 mm. We have compared them with numerous specimens of this species from Woods Hole, Massachusetts, with which they seem to agree perfectly.

Known from Cape Cod southward to Panama. Our specimens are from Porto Bello. It previously was not recorded from south of Cape Fear, North Carolina.

220. Sphyræna picudilla Poey.

Sphyræna picudilla Poey, Memorias, II, 1860, 162 (Havana); Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 72; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 824; Evermann & Marsh, Bull. U. S. Fish Comm., XX, Pt. I, 1900 (1902), 116.

Head 3.15 to 3.26; depth 7.05 to 7.9; D. V-I, 8 or 9; A. II, 8 or 9; scales 123 to 130.

Body very elongate, slender, little compressed; head long and low, considerably deeper than broad, its upper surface flattish; interorbital area nearly flat, with rather prominent ridges; snout long and pointed, 2.2 to 2.4 in head; eye 4.8 to 5.0; snout moderate, slightly oblique, lower jaw strongly projecting, ending in a conical point; maxillary moderate, failing notably to reach anterior margin of eye, 2.6 to 2.64 in head; teeth moderate, compressed; gill-rakers obsolete; scales small; cheeks and opercles scaly; the scales on cheeks not much reduced in size; upper surface of head mostly naked; dorsal fins well separated, the first with 5 slender spines, the second spine the longest, 3.2 to 3.4 in head; soft dorsal and anal similar, both anteriorly moderately elevated, placed opposite each other; caudal deeply forked, the lower lobe slightly the longer; ventral fins about as long as the pectorals, inserted directly under the origin of the spinous dorsal, much nearer base of last anal ray than tip of lower jaw; pectoral fins failing notably to reach base of ventrals, also failing to reach origin of spinous dorsal, 3.4 to 3.6 in head.

Color uniform grayish brown above, silvery below; upper surface of head and snout black; dorsal and caudal fins dusky; other fins mostly pale.

No specimens were obtained. The above description is based on 3 specimens, respectively 290, 300 and 315 mm. in length. Two of these are from Cuba, and one from Bahia, Brazil. One of the Cuban specimens was identified by Poey, the describer of the species. The species is very closely related to *S. borealis* from which it is probably not distinct. The eye, however, seems to be a little larger in the present species; the interorbital area a little flatter; and the scales a little larger. Owing to the fact that the scales have largely been lost from specimens at hand, we cannot be sure of the last point. We unfortunately have no specimens of like size for comparison. A larger series must be secured before their true relationship can be established.

Known from the West Indies south to Bahia, Brazil; not recorded from Panama.

Family XXXVIII. **Polynemidæ.**

The Threadfins.

Body oblong, compressed; snout conical, projecting beyond mouth; eye anteriorly placed, lateral, with a well developed adipose eyelid; mouth large, nearly or quite horizontal; teeth in villiform bands on jaws, palatines and sometimes on vomer; gill-membranes separate and

free from the isthmus; gills 4, a slit behind the fourth; branchiostegals 7; scales present on body and on head, and usually on the vertical fins; lateral line complete, continued on caudal fin; dorsal fins 2, rather remote from each other, the first with 7 or 8 rather high, feeble spines; caudal fin deeply forked; anal fin either similar to second dorsal or much longer; ventrals abdominal, with I, 5 rays; pectoral fins placed low, in two parts, the lower part consisting of free articulated filaments.

Only 2 genera are known from American waters and only one genus is represented in the Panama collection.

85. Genus **Polynemus** Linnæus.

Polynemus Linnæus, Syst. Nat., Ed. X, 1758, 317 (type *Polynemus paradiseus* Linnæus).

Trichidion Klein, Neuer Schauplatz, etc., III, 1776, 592 (type *Polynemus virginicus* Linnæus).

Polydactylus Lacépède, Hist. Nat. Poiss., V, 1803, 419 (type *Polydactylus plumierii* Lacépède=*Polynemus virginicus* Linnæus).

Teeth in villiform bands on jaws, vomer, palatines and pterygoids; posterior margin of preopercle sharply serrate, its angle with a scaly flap; scales rather small and thin, finely ctenoid; first dorsal with 7 or 8 weak spines, the first and last short; second dorsal and anal about equal in size, each with from about 11 to 14 rays; pectoral with 3 to 9 free filaments, shorter than body.

KEY TO THE SPECIES.

a. Pectoral filaments 7; origin of anal slightly behind origin of second dorsal; scales 53 to 61. *virginicus*, p. 289.

aa. Pectoral filaments 6; origin of anal under origin of second dorsal; scales 55 to 60. *approximans*, p. 290.

aaa. Pectoral filaments 9; origin of anal under middle of base of second dorsal; scales 68 to 75. *opercularis*, p. 292.

221. **Polynemus virginicus** Linnæus.

Polynemus virginicus Linnæus, Syst. Nat., Ed. X, 1758, 317 (America),

Polydactylus plumierii Lacépède, Hist. Nat. Poiss., V, 1803, 419 (Martinique).

Polynemus mango Lacépède. Hist. Nat. Poiss., V, 1803, 413, 417 & 418 (America).

Polynemus americanus Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829, 393 (San Domingo).

? Polynemus oligodon Günther, Cat. Fish. Brit. Mus., II, 1860, 322 (Rio Janeiro; Jamaica).

Trichidion plumieri Gill, Proc. Ac. Nat. Sci. Phila., 1861, 279.

Polydactylus virginicus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 829.

Head 3.3 to 3.5; depth 3.1 to 4; D. VIII-I, 11 to 13; A. 12 to 14; scales 53 to 61.

Body elongate, compressed; head moderate; snout conical, projecting prominently beyond the mouth, 4.5 to 5.3 in head; eye 3.1 to 4; mouth horizontal; maxillary reaching far beyond eye, 2 to 2.15 in head; teeth in villiform bands on jaws, vomer and palatines; posterior margin of preopercle serrate; gill-rakers long, 16 or 17 on the lower limb of the first arch; scales moderate, rather thin, usually lost in young, densely covering all the vertical fins; dorsal fins 2, the origin of the first slightly behind vertical from base of pectorals, first spine very short, the third the longest, exceeding in length the postorbital part of head; origin of second dorsal slightly in advance of origin of anal, highest anteriorly, its posterior margin concave; caudal fin deeply forked, the lobes produced, a little longer than head; anal fin similar to second dorsal and of equal length; ventral fins rather short, inserted about an eye's diameter nearer origin of anal than base of pectoral filaments; pectoral fins rather long, 1.05 to 1.2 in head; the filaments 7 in number, the upper ones longest, sometimes reaching to or beyond origin of anal, about 1.5 the length of head.

Color bluish gray above; sides yellowish silvery; below pale silvery; a dark opercular blotch present. The fins are all more or less punctulate, the pectorals, ventrals and anal sometimes mostly black; the dorsals and caudal more or less yellowish in life.

More than 100 specimens were preserved, ranging from 25 to 255 mm. in length. This species is of considerable commercial importance on the coast of Panama. The young are often very abundant along the shores in shallow water.

Known from Florida, the West Indies and somewhat doubtfully from Brazil. Our specimens are from Toro Point, Colon and Porto Bello.

222. Polynemus approximans Lay & Bennett.

Polynemus approximans Lay & Bennett, Zoöl. Beechey's Voyage, Fishes, 1849, 57 (Mazatlan); Boulenger, Bull. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 3 (Panama Bay; Rio Sabana, Darien).

Trichidion approximans Gill, Proc. Ac. Nat. Sci. Phila., 1862, 258.
Polynemus californiensis Thominot, Bull. Soc. Philom. Paris, Séance du 27 Juin, 1886 (California).
Polydactylus approximans Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 829; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 63 (Panama); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 89 (Panama).

Head 3.2 to 3.5; depth 3 to 3.5; D. VIII-I, 13 or 14; A. III, 13 or 14; scales 55 to 60.

Body moderately elongate, compressed; head moderate; snout conical, much in advance of the mouth, 4.3 to 5.1 in head; eye 3.5 to 4.2; interorbital broad, convex; mouth nearly horizontal, large; maxillary reaching well beyond eye, 2 to 2.3 in head; preopercular margin serrate, more strongly so in young than in adult; gill-rakers long, 16 or 17 on lower limb of first arch; scales moderate, rather thin, ctenoid, present on entire upper surface of head, and on opercle and preopercle; the vertical fins densely scaled; dorsal fins 2, the origin of the first dorsal a little behind vertical from base of pectorals, the first spine very short, the third the longest, exceeding the length of post-orbital part of head; origin of second dorsal over origin of anal, the anterior rays longest, posterior margin of fin deeply concave; caudal fin deeply forked, the lobes produced, pointed, the upper lobe the longer, notably longer than head; anal fin similar to second dorsal and opposite it; ventral fins moderate, inserted considerably nearer base of pectoral filaments than origin of anal; pectoral fins large, 1.05 to 1.3 in head, the pectoral filaments 6 in number, only the upper one notably produced and longer than the pectoral.

Color bluish above; sides yellowish; the lower parts pale; a dark metallic opercular spot present; pectorals and ventrals mostly dusky, the pectorals sometimes nearly black in adult; the other fins mostly pale but usually with dusky punctulations in adult; all the fins usually paler in young than in adult.

There are over 100 specimens, mostly young, at hand, ranging in length from 23 to 273 mm. in length. This species is an important food fish, but it appears to reach a smaller size than *P. opercularis*. The young are very abundant at Taboga Island and Chame Point.

Known from Guaymas to Peru. Our specimens are from Taboga Island, Chame Point, Balboa, Corozal and the Panama City market.

223. Polynemus opercularis (Gill).

Trichidion opercularis Gill, Proc. Ac. Nat. Sci. Phila., 1863, 168 (Cape San Lucas).

Polynemus melanopoma Günther, Trans. Zoöl. Soc. London, VI, 1868, 421 (San José, Guatemala).

Polynemus opercularis Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 9 (Panama; Acapulco; Mazatlan).

Polydactylus opercularis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 830; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 64 (Panama); Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 89 (Panama).

Head 3.5 to 3.6; depth 3.4 to 3.95; D. VIII-I, 12 or 13;; A. III, 13, or 14; scales 68 to 75.

Body elongate, compressed; head moderate; snout conical, projecting notably beyond the mouth, 6.2 to 7.5 in head; eye 3.7 to 5; interorbital broad, convex; mouth large, slightly horizontal; maxillary reaching far beyond eye, 1.65 in head; teeth in broad villiform bands on jaws, vomer and palatines; posterior margin of preopercle serrate; gill-rakers rather long, 18 to 20 on lower limb of first arch; scales rather small, thin, ctenoid, present on upper surface of head to tip of snout and on opercle and preopercle, all the fins except pectorals densely scaled; dorsal fins 2, the origin of the first a little behind vertical from base of pectorals, the first spine extremely short, the fourth the longest, about equal to length of postorbital part of head; origin of second dorsal slightly behind vertical from vent, highest anteriorly, its outer margin deeply concave; caudal fin deeply forked, the lobes pointed, at least as long as head; anal fin inserted under middle of base of second dorsal, similar to second dorsal and of about equal length; ventral fins rather small, inserted a little nearer base of lowest pectoral filament than to vent; pectoral fins rather long, 1.25 to 1.45 in head, the filaments 9 in number, very long, exceeding length of head.

Color bluish black above; sides yellowish; under parts pale; a black opercular blotch present; dorsals and caudal mostly dusky, the median rays of caudal yellow; other fins orange.

This is an important food fish and is much sought by the natives. We preserved five specimens, ranging from 180 to 350 mm. in length.

Known from Mazatlan to Panama. Our specimens were purchased in the Panama City market.

Family XXXIX. **Holocentridæ.**

The Squirrel-fishes.

Body oblong or ovate, moderately compressed; head with large muciferous cavities; eye lateral, usually very large; mouth moderate, oblique; teeth in villiform bands on jaws, vomer and palatines; maxillary broad, with a supplemental bone; premaxillaries protractile; opercle, preopercle and suborbital generally serrate; gill-membranes separate; gills 4, a slit behind the fourth; branchiostegals 8; lateral line present; scales hard, strongly ctenoid or spinous, present on sides of head; dorsal fin long, deeply notched or separate, usually with 11 strong spines, depressible in a groove; caudal forked, with rudimentary rays at base; anal with four spines, the third spine largest; ventrals thoracic; general color red.

key to the genera.

a. Suborbital finely serrate, without enlarged recurved spines; head not wholly covered with spinules; the serrations on scales moderate, not produced into distinct spines.

b. Angle of preopercle without a conspicuously enlarged spine; scales 35 to 38. *Myripristis*, p. 293.

bb. Angle of preopercle with a conspicuously enlarged spine; scales 37 to 51. *Holocentrus*, p. 296.

aa. Suborbital with large, recurved spines; the head entirely covered with spinules; the serrations on the scales strong, the median one or two enlarged, forming spines; no prominently enlarged preopercular spine; scales 35 or 36. *Plectrypops*, p. 301.

86. Genus **Myripristis** Cuvier.

Myripristis Cuvier, Règne Animal, Ed. II, II, 1829, 150 (type *Myripristis jacobus* Cuvier & Valenciennes).

Rhamphoberyx Gill, Proc. Ac. Nat. Sci. Phila., 1863, 87 (type *Rhamphoberyx pœcilopus* Gill).

This genus may be distinguished from *Holocentrus* by the absence of a large spine at angle of preopercle.

key to the species.

a. Eye very large, its diameter much greater than length of post-orbital part of head, 2.2 to 2.3 in head; soft dorsal and anal

covered with small scales; color bright red in life, pale in spirits; a dark bar from upper angle of gill-opening to base of pectoral. *jacobus*, p. 294.

aa. Eye smaller, its diameter about equal to length of postorbital part of head, 2.4 to 2.5 in head; soft dorsal and anal not scaly; color much darker, black bluish; no black bar at shoulder.

b. Teeth moderate, the vomerine patch lance-shaped; second dorsal and anal anteriorly somewhat elevated, their posterior margins more or less convex; the dusky band at base of caudal and below lateral line wanting; ventrals pale, or with a few dusky punctulations. *occidentalis*, p. 295.

bb. Teeth very small, the vomerine patch anchor-shaped; second dorsal and anal anteriorly lower; a dusky band at base of caudal and another beginning 3 or 4 scales behind gill-opening and extending a little behind tip of pectoral. *pœcilopus*, p. 296.

224. Myripristis jacobus Cuvier & Valenciennes.

Myripristis jacobus Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829, 162 (Martinique); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 846.

Myriopristis lychnus Poey, Memorias, II, 1860, 159 (Havana).

Rhinoberyx chryseus Cope, Trans. Amer. Philo. Soc. Phila., XIV, 1871, 464 (St. Croix Islands).

Head 2.9 to 3; depth 2.3 to 2.4; D. X-I, 13 or 14; A. III, 11 or 12; scales 35 or 36.

Body elongate, compressed, rather robust; head short and deep; snout blunt, 5.2 to 5.9 in head; eye very large, its diameter much greater than length of postorbital part of head, 2.2 to 2.3 in head; mouth large, oblique, the lower jaw slightly projecting; maxillary not quite reaching posterior margin of eye, with evident serræ on its lower posterior angle, 1.65 to 1.8 in head; teeth all small; preopercular margin strongly serrate, none of the serræ enlarged; bony margin of opercle serrate, with an enlarged spine at upper posterior angle; gill-rakers long, slender, 21 to 23 on lower limb of first arch; scales large, firm, very strongly ctenoid, wanting on upper surface of head, but present on cheeks and opercle; small scales also present on soft dorsal and anal; dorsal fins separate, the spines rather strong, the soft dorsal anteriorly somewhat elevated, the posterior margin concave; caudal fin deeply forked, the lobes somewhat produced, nearly as long as head; anal fin with 4 strong spines, the third one the strongest, but

not longer than the fourth, the soft part of fin similar to soft dorsal; ventral fins moderate, scarcely as long as snout and eye; pectoral fins moderate, 1.5 to 1.6 in head.

Color in alcohol pale, straw-color, lower parts with a metallic luster; a dark bar from upper angle of gill-opening to behind base of pectoral; fins all pale. Body and fins all bright red in life; shoulder with dark red bar, turning dusky in spirits.

This fish is represented by 7 specimens, ranging from 160 to 190 mm. in length. These were taken on rocky bottom by the use of dynamite.

Known from the West Indies to Brazil. Our specimens are from Porto Bello.

225. Myripristis occidentalis Gill.

Myriopristis occidentalis Gill, Proc. Ac. Nat. Sci. Phila., 1863, 87 (Cape San Lucas).

Rhamphoberyx leucopus Gill, Proc. Ac. Nat. Sci. Phila., 1863, 88 (Cape San Lucas).

Myripristis occidentalis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 847; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 64 (Panama Bay).

Head 2.95 to 3.1; depth 2.4 to 2.6; D. X-I, 13; A. IV, 11 or 12; scales 36 to 38.

Body elongate, compressed; head rather short and broad; snout short, 5.3 to 5.7 in head; eye large, its diameter equal to postorbital part of head, 2.4 to 2.5 in head; mouth rather large, terminal or the lower jaw slightly projecting; maxillary broad, not serrate on its posterior and lower posterior border, reaching well beyond pupil, but not quite to posterior margin of eye, 1.7 to 1.8 in head; teeth small, in villiform bands on jaws, vomer and palatines; preopercular margin finely serrate, none of the serræ enlarged; bony margin of opercle strongly serrate, one of the spines at upper posterior angle enlarged; gill-rakers slender, 19 to 22; scales large, firm, strongly ctenoid, wanting on upper surface of head, but present on cheeks and opercle, not extending on soft dorsal and anal; dorsal fins well separated, the spines slender, but very pungent; soft dorsal low, its posterior margin slightly concave; caudal fin moderately forked, the lobes not especially produced, about equal to distance from tip of snout to preopercular margin; anal fin with 4 spines, the third one strongest, but usually not reaching the tip

of the third, the soft part of the fin similar to the soft dorsal; ventral fins rather long, usually exceeding the length of snout and eye; pectoral fins moderate, 1.45 to 1.6 in head.

Color in alcohol brownish, somewhat paler below than above; lower parts more or less silvery; a dark area on upper posterior part of opercle; the fins all pale. Color in life largely reddish.

This species appears to be rather rare, as only 3 specimens, respectively 135, 155 and 182 mm. in length, were collected. These were taken with dynamite along the rocky shores of some islands.

Known from Cape San Lucas to the Galapagos Islands. Our specimens are from Taboga Island and Balboa.

226. Myripristis pœcilopus (Gill).

Rhamphoberyx pœcilopus Gill, Proc. Ac. Nat. Sci. Phila., 1863, 87 (Cape San Lucas).

Myripristis pœcilopus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 847; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 65 (Panama Bay).

This fish was not taken by us, but Gilbert & Starks, who had 3 specimens from Panama Bay, point out the following differences between this species and *M. occidentalis*: (a) The teeth are much smaller, the vomerine patch of teeth being anchor-shaped rather than lance-shaped. (b) The anterior rays of the second dorsal and anal are less strongly elevated. (c) The scales are somewhat larger, there being 3 or 4 fewer in a lateral series. These authors give the following color description:

"Color of back slaty brown, passing into bright, iridescent silvery at the upper part of the band of scales which bears the lateral line. Upper end of opercle with bluish reflections. Directly below the lateral line is a narrow, straight, dusky streak, commencing three or four scales from gill-opening and ending a little behind tip of pectoral. Tips of ventrals varying from slightly dusky to black. Base of caudal with a dusky band. Spinous dorsal dark or nearly black. Other fins colorless."

Known from Cape San Lucas and Panama Bay.

87. Genus **Holocentrus** Gronow.

Holocentrus Gronow, Zoöphyl., 1763, 65 (type *Holocentrus sogo* Bloch); Bloch, Ichthyol., VII, 1790, 46 (type *Holocentrus sogo* Bloch).

Holocenthrus Scopoli, Intro. Hist. Nat., 1777, 449, (no type mentioned; misprint for *Holocentrus*).

Body oblong, moderately compressed; the ventral outline only a little curved; the back somewhat elevated; head compressed; mouth rather small, terminal; maxillary broad, with a supplemental bone; suborbital, opercle and preopercle all sharply serrate, the opercle with 1 or 2 enlarged spines at posterior angle; preopercle with a large spine at angle, no recurved spines on suborbital; scales moderate, strongly serrate; the dorsal fins scarcely separate, the spines usually 11; caudal fin forked; anal spines 4, the first one very small.

KEY TO THE SPECIES.

a. Caudal lobes notably produced, the upper one much longer than the lower; soft dorsal anteriorly very high; scales 47 to 51; gill-rakers 13 to 15; soft dorsal with 15 rays; color mostly pale in spirits. *ascensionis,* p. 297.

aa. Caudal lobes not produced, the upper lobe scarcely longer than the lower one; soft dorsal anteriorly not greatly elevated; scales 37 to 40; gill-rakers 7 to 9; color grayish or bluish above.

b. Opercle with 2 enlarged spines of equal size at angle; soft dorsal with 13 rays; maxillary reaching a little beyond vertical from anterior margin of pupil; color brownish above; dark stripes present between the rows of scales, most distinct on upper part of sides; axil of pectoral deep black. *vexillarius,* p. 299.

bb. Opercle with a single greatly enlarged spine; soft dorsal with 14 rays; maxillary reaching to or beyond vertical from middle of eye, 2.35 to 2.6 in head; color darker; no distinct dark stripes between the rows of scales; axil of pectoral merely brownish. *suborbitalis,* p. 300.

227. Holocentrus ascensionis (Osbeck).

Perca ascensionis Osbeck, Reise nach Ostindien und China, 1765, 388 (Ascension Island).

Bodianus pentacanthus Bloch, Naturg. Ausl. Fische, IV, 1790, 40, Pl. CCXXV (Brazil).

Amphiprion matejuelo Bloch & Schneider, Syst. Ichth., 1801, 206 (Cuba).

Bodianus jaguar Lacépède, Hist. Nat. Poiss., IV, 1803, 286 (Brazil).

Holocentrum longipinne Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829, 185 (Martinique; San Domingo; Porto Rico; St. Thomas; Havana).

Holocentrus ascensionis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 848.

Head 3.2 to 3.55; depth 2.8 to 3.15; D. XI, 15; A. IV, 10; scales 47 to 51.

Body elongate, moderately compressed; the anterior profile convex; head a little longer than deep; snout rather short, 3.9 to 4.4 in head; eye 2.55 to 2.8; interorbital not much more than half the eye in specimens 140 mm. in length, proportionately wider in large specimens; mouth rather large, oblique, terminal; maxillary reaching a little beyond middle of eye, 2.15 to 2.3 in head; teeth all small, in villiform bands on jaws, vomer and palatines; suborbital, opercle and preopercle sharply serrate; preopercle with an enlarged spine at angle at least half the length of eye in large specimens (255 mm.), proportionately shorter in young; opercle with a large spine at posterior angle, the next spine below it also somewhat enlarged, the margin with a U-shaped indentation under tip of preopercular spine; suborbital with only the anterior tooth enlarged; the upper surface of head with ridges, but without spinules except over and back of eye; gill-rakers slender, scarcely as long as pupil, 13 to 15 developed on the lower limb of the first arch; scales strongly serrate, wanting on upper surface of head, but present on preopercle and one series on opercle, extending on caudal fin, base of pectorals, but not on the other fins; dorsal fins not separate, the last spine connected with the first soft ray by membrane, the spines strong, the third longest, about half the length of head, the soft part anteriorly notably elevated, the longest rays nearly as long as head in adult, the posterior rays decreasing rapidly in length; caudal fin deeply forked, the lobes pointed, the upper one much the longer; anal fin with 4 spines, the third much enlarged, reaching past the tip of the fourth, nearly as long as the longest soft rays and equaling about half the head; ventral fins notably longer than the pectorals, inserted well behind the base of pectorals; pectoral fins rather short, 1.4 to 1.7 in head.

Color in life reddish above, with bluish reflection and brownish stripes between the rows of scales; sides becoming paler red with silvery and bluish reflections, the brownish stripes between the rows of scales less distinct than along back; chest and abdomen pale red; head bright red; iris red; cornea brown; spinous dorsal yellowish red; the other fins all bright red. The body becomes largely pale in spirits, the lines between the rows of scales being only faintly visible; the fins are all pale; the upper parts and head become brownish dusky; a pale bar extends from maxillary to just below preopercular spine.

This species is represented by 35 specimens, ranging in length from 140 to 255 mm. It lives among rocks, and in the vicinity of Panama, principally on coral reefs and it is fairly abundant. It is, however, only occasionally seen in the market.

Known from Florida to Brazil. Also recorded from the eastern Atlantic. Our specimens are from Toro Point, Colon and Porto Bello.

228. Holocentrus vexillarius Poey.

Holocentrum vexillarium Poey, Memorias, II, 1860, 158 (Cuba).

Holocentrus vexillarius Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 852.

Head 3.1; depth 2.6 to 2.7; D. XI, 13; A. IV, 9; scales 39 or 40.

Body moderately slender, compressed; head not much longer than deep; snout rather acute, 4.35 in head; eye 2.4 to 2.65; interorbital about three-fourths the width of eye; mouth oblique, terminal; the maxillary reaching a little beyond vertical from anterior margin of pupil, 2.65 to 2.8 in head; teeth minute, in villiform bands on jaws, vomer and palatines; suborbital, opercle and preopercle sharply serrate; preopercle with a moderately large spine at angle, about as long as pupil; opercle with 2 spines of equal length at posterior angle; the anterior spine of suborbital somewhat enlarged; gill-rakers very short, 9 developed on lower limb of first arch; scales strongly serrate, the arrangement as in *H. ascensionis*; the dorsal fins scarcely connected, the spines moderate, the third longest, about half the length of head, the soft part anteriorly moderately elevated, the longest rays, however, scarcely as high as the longest spine; caudal fin forked, the lobes not much produced, the upper one scarcely longer than the lower; anal fin with 4 spines, the third one much enlarged, reaching much beyond the tip of the fourth to tip of the longest soft rays, about equal to distance from tip of snout to preopercular margin; ventral and pectoral fins of about equal length, 1.4 in head.

Color in alcohol dusky brown above, with dark stripes between the rows of scales; lower parts pale, the stripes between the rows of scales on lower part of sides represented by dusky points, wanting on belly; head brownish, the cheeks and opercles with dark points; spinous dorsal more or less dusky, the membranes pale behind each spine and black in front, the black not extending either to the base or to the tips of the membranes between the first and second and the second and third spines, but extending as an oblique bar from spine to spine; the other fins all pale; the axil of pectoral black.

This species is represented by 5 specimens, ranging from 95 to 110 mm. in length. It was not distinguished from *H. ascensionis* at the time of capture and no color notes were taken. The species of this genus are so poorly defined that we cannot be certain of the proper disposition of our specimens, but they certainly are identical with those from Porto Rico described by Evermann & Marsh, "The Fishes of Porto Rico," (Bulletin of the U. S. Bureau of Fisheries, XX, Pt. I, 1900 (1902), p. 119).

Recorded from Porto Rico and Cuba. Our specimens are from Colon and Porto Bello.

229. Holocentrus suborbitalis Gill.

Holocentrum suborbitale Gill, Proc. Ac. Nat. Sci. Phila., 1863, 86 (Cape San Lucas).

Holocentrus suborbitalis Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 850; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 66 (Panama); Kendall & Radcliffe, Memoir. Mus. Comp. Zool., XXXV, 1912, 94 (Toboguilla and Perico Islands, Panama Bay, etc.).

Head 2.85 to 3.2; depth 2.4 to 2.7; D. XI, 14 (rarely 13); A. IV, 9; scales 37 to 39.

Body rather deep, robust, moderately compressed; head rather short; snout blunt, 4.35 to 4.6 in head; eye 2.55 to 2.9; interorbital broad, at least three-fourths the diameter of eye in large specimens (190 mm.), proportionately narrower in young, but always more than half the width of eye; mouth moderate, oblique, terminal, maxillary reaching to or slightly beyond vertical from middle of eye, 2.35 to 2.6 in head; teeth all small, in villiform bands on jaws, vomer and palatines; suborbital, opercle and preopercle sharply serrate, the preopercle with a very large spine at angle, about three-fourths the length of eye in adult, proportionately much shorter in young; opercle with a large spine at posterior angle, the next spine above it also somewhat enlarged, the margin with a broad U-shaped indentation under preopercular spine; suborbital with only the anterior tooth somewhat enlarged; upper surface of head with ridges, and with spinules over and back of eye; gill-rakers short and blunt, 7 or 8 developed on the lower limb of first arch; scales strongly ctenoid, the arrangement as in *H. ascensionis*; dorsal fins scarcely connected, the membrane between the last spine and the first soft ray very low, the spines strong, the third spine longest, about half the length of head; the second dorsal anteriorly somewhat elevated, the longest rays about equal in length to longest spine; cau-

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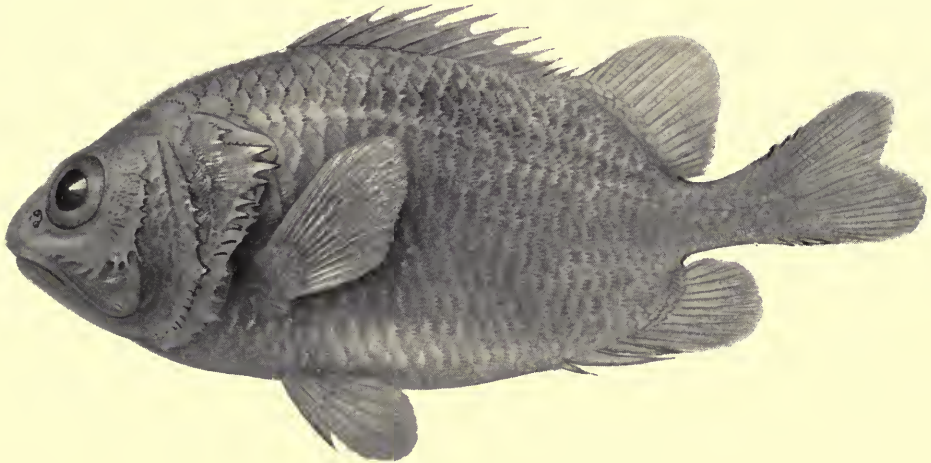

PLECTRYPOPS RETROSPINIS (Guichenot).
From a specimen 115 mm. in length.

dal fin forked, the lobes not produced, rounded, and the upper scarcely longer than the lower; anal fin with 4 spines, the third spine much enlarged, reaching far beyond the tip of the third spine, notably longer than the longest soft rays, scarcely shorter than distance from tip of snout to preopercular margin; ventral and pectoral fins of about equal length, 1.35 to 1.5 in head.

Color in life largely dark red; the back more or less steel-gray; sides and back with purple reflections; head dark red, a narrow, curved, silvery stripe from snout to under back of eye; another silvery streak on margin of preopercle; spinous dorsal brownish, with pale spots at base of membranes; the other fins mostly red. Color in spirits dark grayish brown above, lower parts pale, the silvery and bluish reflections remaining; the body and head everywhere except on lower surface with coarse brown punctulations.

This is a rather common species among the rocks and in tide pools. We preserved 47 specimens, ranging from 57 to 190 mm. in length. This fish is used to a limited extent as food, but it is not often seen in the market.

Known from Cape San Lucas to the Galapagos Islands. Our specimens are from Taboga Island, Balboa, and Panama City.

88. Genus **Plectrypops** Gill.

Plectrypops Gill, Proc. Ac. Nat. Sci. Phila., 1862, 237 (type *Holocentrum retrospinis* Guichenot).

This genus may be distinguished from *Holocentrus* by the more strongly serrate suborbital which bears recurved spines, by the absence of an enlarged preopercular spine, by the numerous spinules covering the entire head and by the enlarged median serræ of the scales.

A single species is known.

230. Plectrypops retrospinis (Guichenot). (Plate XXIII.)

Holocentrum retrospinis Guichenot, in Sagra, Hist. Phys. Polit. Nat. Cuba, IV, Pt. II, 1853, 35, Pl. I, fig. 3 (Cuba).

Holocentrum prospinosum Poey, Memorias, II, 1861, 343 (Cuba).

Plectrypops retrospinis Gill, Proc. Ac. Nat. Sci. Phila., 1862, 237; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 853.

Head 2.4 to 2.5; depth 2.15 to 2.3; D. XI-I, 14; A. IV, 11; scales 35 or 36.

Body short, rather deep, compressed; the back elevated; the anterior profile gently convex to nearly straight over the eyes; head rather short and deep; snout shorter than eye, 5.3 to 5.8; eye 3.4 to

3.9; mouth large, oblique, terminal; maxillary very broad, reaching beyond eye, 1.75 to 1.85 in head; teeth small, in villiform bands, present on jaws only; opercle, preopercle and suborbital all strongly spinous; the opercle with 2 enlarged spines at posterior angle; no especially enlarged spine at angle of preopercle; the suborbital with 2 to 5 strong, recurved spines; gill-rakers moderate, 14 or 15 on lower limb of first arch; scales strongly serrate, wanting on head, except on opercle and preopercle, the former with a single row; no scales on vertical fins; the head everywhere with spinules; dorsal fins separate, the spines rather strong, the third and fourth spines longest, a little shorter than snout and eye; the soft dorsal short, highest anteriorly, the posterior rays not more than half the length of the anterior ones; caudal fin forked, the lobes broadly rounded; anal fin with 4 spines, the first one very small, scarcely projecting above the scales, the third spine strongest, usually reaching past the tip of the third when deflexed; ventral fins moderate, somewhat shorter than pectorals, inserted under base of pectorals; pectoral fins rather broad, the upper rays longest, 1.6 to 1.75 in head.

Color in life bright red, the lower parts slightly paler; the iris and fins of the same color as body. These colors all fade in spirits, leaving a pale straw-color.

This fish, which has rarely appeared in collections, is represented by 9 specimens, ranging in length from 73 to 115 mm. It lives among the rocks and was taken only by the use of dynamite. This fish is easily distinguished by the recurved spines on the suborbital. These spines were incorrectly assigned to the preopercle by Jordan & Evermann in the generic description. The recurved suborbital spines are not definitely 3 in number, and occasionally not present in an equal number on both suborbitals of the same fish.

Previously recorded from the Bermudas and from Cuba. Our specimens are from Toro Point and Porto Bello.

Family XL. **Mullidæ.**

The Surmullets.

Body elongate, more or less compressed; head rather deep, its upper profile strongly convex; eye moderate, placed high; mouth small, low, terminal; premaxillaries more or less protractile; maxillaries thin, nearly as broad at base as at tip, without supplemental bone; preopercle entire or slightly serrate; opercle unarmed or with a single spine; branchiostegals 4; pseudobranchiæ present; two long,

unbranched barbels attached just back of symphysis of lower jaw; teeth mostly small, variously placed; no canines, incisors, or molars; scales large, usually slightly ctenoid, present on head and body; lateral line complete, the pores often branched; dorsal fins 2, far apart, the first with 6 to 8 spines; anal fin short, similar to soft dorsal, with 1 or 2 small spines; ventral fins thoracic, I, 5; vertebræ 9 + 14; stomach siphonal; pyloric cæca about 20.

89. Genus **Upeneus** Cuvier.

Upeneus Cuvier, Règne Animal, Ed. II, II, 1829, 157 (type *Mullus bifasciatus* Lacépède).

Pseudupeneus Bleeker, Versl. Ak. Amsterdam, XIV, 1862, 134 (type *Upeneus prayensis* Cuvier & Valenciennes).

Parupeneus Bleeker, Nederl. Tijdsch. Dierk., I, 1863, 342, 345 (type *Mullus bifasciatus* Lacépède).

Body oblong, compressed; head moderate; mouth low, nearly horizontal; jaws subequal; the bone forming a hook above maxillary rather small; eye placed high; interorbital space flat or slightly concave; opercle deep, with a single posterior spine; barbels nearly as long as head; teeth rather short and strong, unequal, in one or two irregular series in each jaw, none on vomer or palatines; scales large, ctenoid; lateral line complete, the pores branched; dorsal fins separate, the first with 7 or 8 spines; anal with 1 or 2 spines; caudal fin forked.

KEY TO THE SPECIES.

a. Scales large, 30 to 32 in a lateral series.

b. Body rather slender, the depth 3.6 to 4.05 in length; mouth small, the maxillary not nearly reaching anterior margin of eye, 3.3 to 3.6 in head; sides with 3 or 4 black blotches. *maculatus*, p. 303.

bb. Body deep, the depth 2.7 to 3.3 in length; mouth larger, the maxillary reaching nearly or quite to anterior margin of eye, 2.66 to 3.05 in head; sides with 2 black blotches. *grandisquamis*, p. 305.

aa. Scales smaller, 39 or 40 in a lateral series; sides with a yellowish longitudinal streak. *martinicus*, p. 306.

231. Upeneus maculatus (Bloch).

Mullus maculatus Bloch, Naturg. Ausl. Fische, VII, 1793, 95 (Brazil).

Upeneus maculatus Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829, 478; Günther, Cat. Fish. Brit. Mus., I, 1859, 408; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 858, Pl. CXXXII, fig. 362.

Upeneus punctatus Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829, 482 (Martinique).

Mullhypeneus maculatus Poey, Syn. Pisc. Cub., 1868, 307.

Head 3.1 to 3.23; depth 3.6 to 4.05; D. VIII-I, 8; A. I or II, 6; scales 30 to 32.

Body elongate; anterior profile nearly evenly convex, slightly angled in front of eyes; ventral outline anteriorly nearly straight; head moderately elongate, convex above; skull only slightly expanded in advance of eyes; snout rather long and pointed, 1.8 to 2.3 in head; eye 3.65 to 4.8; mouth moderate, nearly horizontal; lower jaw included; maxillary not nearly reaching eye, 3.3 to 3.6 in head; teeth in the jaws short and blunt, mostly uniserial, sometimes more or less irregularly biserial anteriorly in lower jaw; gill-membranes rather broadly united across the isthmus; gill-rakers well developed, 15 to 17, exclusive of 3 or 4 rudiments, on lower limb of first arch; scales large, sharply ctenoid; lateral line following the curve of the back, the pores considerably branched; dorsal fins 2, well separated, the first with 8 spines, the first spine very short, the others rather long and slender, the longest a little shorter than pectorals; second dorsal rather low, its outer posterior margin slightly convex, inserted a little in advance of the anal; caudal fin forked, the lobes of equal length; anal slightly shorter than the second dorsal, its outer posterior margin slightly concave; ventral fins large, a little longer than the pectorals, inserted under their bases; pectoral fins inserted below longitudinal axis of body, 1.43 to 1.65 in head.

Color in alcohol grayish above, pale below; sides with about 4 dark blotches; dorsal fins and caudal slightly dusky; other fins pale. Color in life greenish brown above; sides green, with tinge of red; pale below; a broken reddish brown band extending from eye backward on upper half of caudal peduncle, making about 4 broad, brownish blotches along sides; lower part of head red; barbels yellow; sides of head with a blue line from maxillary passing under eye to upper angle of gill-opening, 3 narrower bluish lines above this one; rows of scales above lateral line, and one row just below lateral line, each with a row of bluish dots; dorsal fins and upper lobe of caudal greenish, with a tinge of red; lower lobe of caudal, anal, ventrals and pectorals red.

Of this species there are 54 specimens, ranging from 60 to 220 mm. in length, in the present collection.

Known from Florida south to Rio Janeiro. Our specimens are from Fox Bay, Colon; and Porto Bello.

232. Upeneus grandisquamis Gill.

Upeneus grandisquamis Gill, Proc. Ac. Nat. Sci. Phila., 1863, 168 (West Coast of Central America); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 6; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 860; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 67.

Upeneus tetraspilus Günther, Proc. Zoöl. Soc. London, 1864, 148 (Panama), and Trans. Zoöl. Soc. London, VI, 1868, 420, Pl. LXVI, fig. 1.

Head 3.0 to 3.5; depth 2.7 to 3.3; D. VIII-I, 8; A. I, 6; scales 30 to 32.

Body rather deep, anterior profile rather steep, somewhat angled in front of eyes; ventral outline anteriorly straight; head moderate, convex above; skull expanded in advance of eyes; snout rather short and blunt, its length 2.1 to 2.53 in head; eye 3.9 to 4.5; mouth rather large, nearly horizontal; lower jaw included; maxillary reaching nearly or quite to anterior margin of eye, 2.66 to 3.05 in head; teeth in anterior part of jaws biserial, those of the outer series in upper jaw very obtuse and partly confluent; gill-membranes rather broadly united across the isthmus; gill-rakers moderately developed, 12 to 14, exclusive of rudiments, on lower limb of first arch; scales large, ctenoid; lateral line following the curve of the back, the pores branched; dorsal fins 2, well separated, the first with 8 spines, the first one short, the others rather long, the longest not much shorter than pectorals; second dorsal rather low, its outer posterior margin nearly straight; ventral fins large, nearly as long as pectorals, inserted under their base; pectoral fins inserted below longitudinal axis of body, 1.24 to 1.43 in head.

Color light greenish brown above, rose-color below lateral line; a pearly spot on center of each scale; a larger black blotch on lateral line behind spinous dorsal; a smaller and somewhat indistinct black spot behind orbit; dorsal fins spotted with color of back; other fins plain.

Of this species 20 specimens, ranging from 85 to 195 mm. in length, were preserved.

Known from the Pacific coast of Central America from Guaymas to Panama. Our specimens are from Chame Point, Naos Island and Panama market.

233. Upeneus martinicus Cuvier & Valenciennes.

Upeneus martinicus Cuvier & Valenciennes, Hist. Nat Poiss., III, 1829, 483 (Martinique); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 859.

Upeneus balteatus Cuvier & Valenciennes, Hist. Nat. Poiss., III, 1829. 484 (Cuba).

Upeneus flavo-vittatus Poey, Memorias, I, 1851, 224 (Cuba).

Mulloides flavovittatus Günther, Cat. Fish. Brit. Mus., I, 1859, 403.

Head 3.25 to 3.6; depth 3.5 to 4.2; D. VII-I, 8; A. II, 6; scales 39 or 40.

Body moderately elongate; profile ascending strongly from tip of snout to anterior margin of eyes, from thence to first dorsal only slightly convex and little elevated; ventral outline anteriorly nearly straight; head rather short and flat above; skull broadened in front of eyes; snout rather short and blunt, its length 2.35 to 3.0 in head; eye 3.4 to 3.7; mouth moderate, horizontal; lower jaw included; maxillary failing to reach anterior margin of eye, 3.14 to 3.3 in head; teeth in the jaws blunt, in front in 3 irregular series, then in 2 series and posteriorly in a single series; gill-membranes nearly separate; gill-rakers well developed, 16 or 17, exclusive of 3 or 4 rudiments, on lower limb of first arch; scales moderate, sharply ctenoid; lateral line following the curve of the back, the pores much branched; dorsal fins 2, well separated, the first with 7 rather strong spines, the short one, usually preceding the long spines in other species of this genus, wanting in specimens at hand, the longest spine a little longer than pectorals; second dorsal and anal similar, rather small, and placed opposite each other, their outer posterior margins concave; caudal fin deeply forked, the lobes of about equal length; ventral fins as long as the pectorals, inserted under their base, 1.57 to 1.73 in head.

Color in alcohol grayish above, pale below; a slight trace of a pale stripe on anterior portion of the body below lateral line; fins all pale. Color in life mostly reddish; stripe on sides yellow.

A single specimen of this species, 275 mm. in length, was obtained. We have also examined 2 specimens from Nassau and one from

St. Croix, ranging from 115 to 255 mm. in length. The above description is based on all the material examined.

Known from Florida south to Panama. Our specimen is from Porto Bello. Previously not recorded from south of the West Indies.

Family XLI. Scombridæ.

The Mackerels.

Body elongate, more or less fusiform, not much compressed; head conical; snout pointed; mouth large, cleft lateral; premaxillaries not protractile; maxillary concealed by preorbital or not, without a supplemental bone; jaws with sharp teeth, large or small; vomer and palatines with or without teeth; preopercle in very young with radiating spines, entire in adult; opercle unarmed; gill-openings wide, the membranes separate, free from the isthmus; pseudobranchiæ large; gills 4, a slit behind the fourth; gill-rakers usually long; branchiostegals 7; scales small, usually covering entire body, sometimes forming a corselet about pectoral region; caudal peduncle slender, usually with a median, lateral keel; dorsal fins 2, the first with rather weak spines, depressible in a groove; second dorsal and anal similar, anteriorly more or less elevated, each followed by a series of finlets; anal spines weak; caudal very broadly forked; ventral fins of moderate size, thoracic, I, 5; pectorals long or short; vertebræ 31 to 66. Prevailing color steel-blue above; more or less silvery below.

KEY TO THE GENERA.

a. Maxillary wholly concealed by preorbital; no median keel on caudal peduncle. *Scomber*, p. 308.

aa. Maxillary not wholly concealed by preorbital; median keel on caudal peduncle more or less developed.

b. Scales present on anterior part of body only, forming a corselet, the rest of body naked; palatine teeth wanting.

c. Dorsal fins close together, contiguous; the first with 15 or 16 spines. *Gymnosarda*, p. 310.

cc. Dorsal fins far apart, the interval between them nearly equaling the length of the head; the first with 9 or 10 spines. *Auxis*, p. 312.

bb. Entire body covered with scales, sometimes very small or rudimentary, forming a corselet or not; palatine teeth present.

d. Snout of moderate length, not beak-like; maxillary posteriorly exposed, not concealed by preorbital.

e. Teeth on jaws small, conical, not compressed; gill-rakers long and slender, numerous, 20 or more on lower limb of first arch.

f. Body oblong, compressed, not exceptionally robust; pectoral fins of moderate length, always notably shorter than head. *Thunnus*, p. 314.

ff. Body short, slightly compressed, very robust; pectoral fins of extreme length, much longer than head. *Germo*, p. 315.

ee. Teeth on jaws rather strong, more or less compressed, sometimes triangular, with sharp cutting edges; gill-rakers rather short, fewer than 20 on lower limb of first arch.

g. Vomer toothless; palatine teeth in a single series, similar in size and shape to those on jaws; first dorsal long, with 18 to 22 spines; scales of pectoral region forming a rather distinct corselet. *Sarda*, p. 317.

gg. Vomer and palatines with bands of granular teeth; first dorsal rather short, with 14 to 18 feeble spines; scales not forming a corselet. *Scomberomorus*, p. 321.

dd. Snout extremely long, beak-like, longer than rest of head; maxillary posteriorly concealed by preorbital. *Acanthocybium*, p. 326.

90. Genus **Scomber** Linnæus.

Scomber Linnæus, Syst. Nat., Ed. X, 1758, 297, (type *Scomber scombrus* Linnæus).

Cordylus Gronow, Cat. Fish, 1854, 163, (type *Scomber scombrus* Linnæus.

Body elongate, nearly fusiform, very slightly compressed; head long and low; mouth rather large; maxillary slipping entirely under preorbital; teeth small, in a single series on jaws, vomer and palatines; gill-rakers long and slender; lateral line not forming a medium keel on caudal peduncle; scales small, covering entire body, not forming a corselet; first dorsal with 9 to 12 slender spines, separated from second dorsal by a space about equal to length of its base; second dorsal and anal each followed by 5 to 9 finlets; ventrals and pectorals small, the latter inserted on level with eyes.

234. Scomber colias Gmelin.

Scomber colias Gmelin, Syst. Nat., I, 1789, 1329 (Sardinia); Dresslar & Fesler, Bull. U. S. Fish. Comm., VII, 1887 (1889), 432; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 866, Pl. CXXXIII, fig. 364.

Scomber lacertus Walbaum, Artedi Piscium, III, 1792, 209 (Sardinia).

Scomber pneumatophorus Delaroche, Ann. Mus. Hist. Nat. Paris, XIII, 1809, 315 & 334 (Balearic Islands).

Scomber macropthalmus Rafinesque, Ind. d'Itt. Sicil., etc., 1810, 15 (Palermo).

Scomber grex Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 422 (New York).

Scomber maculatus Couch, Mag. Nat. Hist., V, 1832, 22 (England).

Scomber undulatus Swainson, Nat. Hist. & Class. Fish., II, 1839, 409 (Sicily).

Scomber gracilis Swainson, Nat. Hist & Class. Fish., II, 1839, 410 (Sicily).

Scomber diego Ayres, Proc. Cal. Ac. Sci., 1856, 92 (Santa Barbara).

Scomber Dekayi Storer, Fishes Massachusetts, 1867, 53, Pl. XI, fig. 1 (Coast of Massachusetts).

Head 3.34 to 3.8; depth 4.5 to 5.85; D. X or XI-11 or 12-V; A. I-I, 10 to 12-V.

Body elongate, nearly fusiform, very slightly compressed; dorsal and ventral outlines about evenly curved; head long and low; snout pointed, its length 3.12 to 3.7 in head; eye 3.9 to 4.8; mouth moderate, oblique; jaws subequal; maxillary reaching anterior margin of pupil, 2.4 to 2.65 in head; teeth small, present on jaws, vomer, and palatines; gill-rakers slender, nearly as long as eye, 25 to 30 on lower limb of first arch; lateral line without a distinct curve; no keel on caudal peduncle; scales small, covering entire body; first dorsal with 10 or 11 spines, the anterior ones long and slender, equal to length of eye and snout, the posterior ones very short; second dorsal and anal similar, very small, each with 4 or 5 finlets; caudal very broadly forked; ventrals and pectorals rather small, the latter 2.4 to 2.65 in head.

Color bluish above, silvery below; back with numerous wavy blackish streaks or reticulations; a black axillary spot present.

This species was not taken by us. Here described from 9 specimens, ranging in length from 95 to 315 mm. Specimens examined are from Italy, Massachusetts, New York, California, Japan and Corea.

A very widely distributed species which inhabits both the Atlantic and Pacific oceans, but not yet recorded from either coast of Panama.

91. Genus **Gymnosarda** Gill.

Gymnosarda Gill, Proc. Ac. Nat. Sci. Phila., 1862, 125 (type *Thynnus unicolor* Rüppell).

Body elongate, somewhat compressed, robust; head large, tapering rather strongly to pointed snout; mouth moderate; maxillary not concealed by preorbital; teeth present on jaws only, small and in a single series; gill-rakers long and slender, numerous; lateral line with or without an evident downward curve, with a feebly or moderately developed median keel on caudal peduncle; scales present on anterior part of body, forming a distinct corselet, the rest of body naked; first dorsal with 15 or 16 spines, contiguous to second dorsal; second dorsal and anal each followed by 6 to 8 finlets; ventrals and pectorals small, the latter inserted on level with about middle of eyes.

KEY TO THE SPECIES.

a. Lateral line with a distinct downward curve under second dorsal; gill-rakers numerous, 37 on lower limb of first arch; sides below lateral line with several black longitudinal stripes. *pelamis*, p. 310.

aa. Lateral line without an evident downward curve under second dorsal; gill-rakers fewer, 23 to 27 on lower limb of first arch; several black spots, about the size of pupil, below base of pectorals; sides below lateral line without black longitudinal stripes. *alletterata*, p. 311.

235. **Gymnosarda pelamis** (Linnæus).

Scomber pelamis Linnæus, Syst. Nat., Ed. X, 1858, 297 ("In Pelago inter Tropicos").

Scomber pelamides Lacépède, Hist. Nat. Poiss., III, 1802, 14 (after Linnæus).

Thynnus pelamys Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 113, Pl. CCXIV.

Orcynus pelamys Poey, Syn. Pisc. Cub., 1868, 362.

Euthynnus pelamys Jordan & Gilbert, Bull. U S.. Nat. Mus., XVI, 1883, 430.

Gymnosarda pelamis Dresslar & Fesler, Bull. U. S. Fish. Comm., VII, 1887 (1889), 436; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 868.

Head 3.1 to 3.45; depth 3.75 to 3.8; D. XV-14 or 15-VIII; A. II, 13-VII.

Body elongate, somewhat compressed, robust; dorsal and ventral outlines about evenly curved; head large; snout sharply pointed, its length 3.45 to 3.55 in head; eye 5.8 to 6.7; mouth of moderate size, oblique; jaws subequal; maxillary reaching anterior margin of pupil, 2.5 to 2.7 in head; teeth in the jaws small, in a single series, none on vomer, palatines, or tongue; gill-rakers long and slender, nearly as long as eye, 37 on lower limb of first arch; lateral line with a downward curve under second dorsal, then horizontal to caudal fin; a very feebly developed keel on caudal peduncle; first dorsal with 15 spines, the anterior ones the longest, as long as eye and snout, the posterior ones very short; second dorsal and anal similar, small, somewhat elevated anteriorly, their outer margin concave, each with 7 or 8 finlets; caudal very broadly forked; ventrals and pectorals rather small, the latter 2.05 to 2.15 in head.

Color bluish above, silvery below; sides below lateral line with several longitudinal stripes, which on some specimens follow the curve of the abdomen, but on others are straight and horizontal; tongue and inside of mouth silvery.

This species was not taken by us. It is here described from 2 specimens, one from San Diego, California, and the other from Japan, respectively 460 and 415 mm. in length.

A pelagic species, inhabiting all warm seas, but not yet recorded from either coast of Panama.

236. Gymnosarda alletterata (Rafinesque).

Scomber alletteratus Rafinesque, Caratteri, etc., 1810, 46 (Palermo).

Thynnus leachianus Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 414 (Nice).

Scomber quadripunctatus Geoffroy St. Hilaire, Descr. Egypte, Poiss., 1827, Pl. XXIV, fig. 3 (Egypt).

Thynnus thunnia Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 104, Pl. CCXII (Mediterranean).

Thynnus brasiliensis Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 110 (Brazil).

Thynnus brevipinnis Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 112 (Mediterranean).

Thynnus affinis Cantor, Cat. Malay Fishes, 1850, 106 (Sea of Pinang).

Orcynus alliteratus Gill, Rept. U. S. Fish. Comm., I, 1871-72 (1873), 802.

Orcynus thunnina Poey, Enumeratio, 1875, 72.

Thynnichthys thunnina Giglioli, Cat. dei Pesci Italiani, 1880, 25.

Thynnichthys brevipinnis Giglioli, Cat. dei Pesci Italiani, 1880, 25.
Euthynnus alliteratus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 430.
Gymnosarda alletterata Dresslar & Fesler, Bull. U. S. Fish. Comm., VII, 1887 (1889), 436.
Gymnosarda alleterata Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 869, Pl. CXXXIV, fig. 366.

Head 3.45 to 3.6; depth 3.8 to 4.1; D. XV or XVI-11 to 13-VIII; A. II, 12 or 13-VI or VII.

Body elongate, somewhat compressed, robust; dorsal and ventral outlines about evenly curved; head large; snout pointed, its length 3.25 to 3.7 in head; eye 5.25 to 6.5; mouth rather large, oblique; jaws subequal; maxillary reaching middle of eye, 2.3 to 2.6 in head; teeth present on jaws only, small, in a single series; gill-rakers rather long and slender, not much shorter than eye, 23 to 27 on lower limb of first arch; lateral line sometimes more or less wavy, never with a distinct downward curve under second dorsal; keel on caudal peduncle moderately developed; first dorsal with 15 or 16 spines, the anterior ones the longest, as long as snout and eye, the posterior ones very short; second dorsal and anal similar, small, somewhat elevated anteriorly, their outer margin concave, each with 6 to 8 finlets; caudal very broadly forked; ventrals and pectorals small, the latter 1.62 to 2.05 in head.

Color bluish above, silvery below; sides above lateral line usually with short, oblique, black lines running upward and backward, these sometimes broken up into more or less distinct black spots. In a few of the alcoholic specimens at hand the back appears to be perfectly plain, without lines or spots. Region below pectorals with several black spots of about the size of pupil; no black stripes below lateral line.

This species was not taken by us. It is here described from 6 specimens, ranging in length from 270 to 950 mm. Specimens examined are from Massachusetts; Florida; Hawaiian Islands; Philippine Islands and Java.

A pelagic species known from all warm seas; not recorded from either coast of Panama.

92. Genus **Auxis** Cuvier.

Auxis Cuvier, Règne Animal, Ed. II, II, 1829, 199 (type *Scomber rochei* Risso=*Scomber thazard* Lacépède).

Body nearly fusiform, slightly compressed, robust; head large, tapering strongly to pointed snout; mouth rather small; maxillary not

concealed by preorbital; teeth minute, present on jaws and occasionally a few on vomer; gill-rakers rather long and slender; lateral line without but a distinct arch; a rather small keel on caudal peduncle; scales present on anterior portion of body, forming a corselet, the rest of body naked; first dorsal with 9 or 10 spines, separated from second dorsal by a space nearly equal to length of head; second dorsal and anal each followed by 7 or 8 finlets; ventrals and pectorals small, the latter inserted on level with eyes.

237. Auxis thazard (Lacépède).

Scomber thazard Lacépède, Hist. Nat. Poiss., III, 1802, 9 (Off coast of New Guinea).

Scomber rochei Risso, Ichth. de Nice, 1810, 165 (Nice).

Scomber bisus Rafinesque, Caratteri, etc., 1810, 45 (Palermo).

Thynnus rocheanus Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 417 (Nice).

Auxis vulgaris Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 139, Pl. CCXVI (Mediterranean).

Auxis tapeinosoma Bleeker, Verh. Batav. Gen., XXVI, 1854, 98, Pl. VII, fig. 1 (Japan).

Auxis thynnoides Bleeker, Nat. Tijd. Ned.-Ind., VIII, 1855, 301 (Ternate).

Auxis rochei Günther, Cat. Fish. Brit. Mus., II, 1860, 369; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 425.

Auxis thazard Dresslar & Fesler, Bull. U. S. Fish Comm., VII, 1887 (1889), 434; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 867, Pl. CXXXIII, fig. 365.

Head 3.45 to 3.8; depth 4.0 to 4.8; D. IX or X-10 or 11-VIII; A. II, 10 or 11-VII.

Body nearly fusiform, slightly compressed, robust; the ventral outline a little more strongly convex than the dorsal; head large; snout pointed, its length 4.2 to 4.8 in head; eye 5.15 to 5.5; mouth moderate, rather strongly oblique; jaws subequal; maxillary reaching to or slightly past anterior margin of pupil, 3.0 to 3.35 in head; teeth minute, present on jaws, and occasionally a few on vomer, none on palatines; gill-rakers very slender, about three-fourths the length of eye, 29 to 32 on lower limb of first arch; lateral line more or less wavy, without a distinct arch; keel on caudal peduncle not greatly developed; first dorsal with 9 or 10 spines, the anterior ones the longest, as long as snout and eye, decreasing rapidly in length posteriorly, separated from soft dorsal by a distance not much shorter than head; second dorsal and anal simi-

lar, very small, each with 7 or 8 finlets; caudal very broadly forked; ventrals capable of being partly covered by the corselet, slightly shorter than snout and eye; pectorals short, 1.97 to 2.38 in head.

Color bluish above, silvery below; sides above lateral line and behind corselet with black spots or more or less wavy bars; no markings of any kind below lateral line.

This species was not taken by us. It is here described from 6 specimens, ranging in length from 235 to 365 mm. Specimens examined are from Woods Hole, Massachusetts; Hawaii; and Java.

Known from all warm seas; not recorded from either coast of Panama.

93. Genus **Thunnus** South.

Thynnus Cuvier, Règne Animal, Ed. I, 1817, 313, (type *Scomber thynnus* Linnæus; preoccupied, a genus of butterflies).

Thunnus South, Encycl. Metro., V, 1845, 620 (type *Scomber thynnus* Linnæus; substitute for *Thynnus* Cuvier, preoccupied).

Orycnus Cooper, Proc. Cal. Ac. Sci., III, 1863, 77 (type *Scomber thynnus* Linnæus; not *Orycnus* Gill, 1861; a misprint of *Orcynus*).

Albacora Jordan, Proc. Ac. Nat. Sci. Phila., 1888, 180 (type *Scomber thynnus* Linnæus; substitute for *Thynnus* Cuvier).

Body oblong, rather deep, compressed; head large, tapering to the conical snout; mouth moderate; maxillary not concealed by preorbital; teeth in jaws small, in a single series, those on vomer and palatines in villiform bands; gill-rakers long and slender, numerous; lateral line without distinct arch or curve, with a feeble keel on caudal peduncle; scales covering entire body, those of corselet notably enlarged; first dorsal with 12 to 15 spines; interval between dorsal fins slight; second dorsal and anal each followed by 8 or 9 finlets; ventrals and pectorals of moderate length, the latter inserted rather high.

238. **Thunnus thynnus** (Linnæus).

Scomber thynnus Linnæus, Syst. Nat., Ed. X, 1758, 297 (Europe; based on *Scomber pinnulis 8 seu 9,* of Artedi).

Scomber albacores Bonnaterre, Tableau Encyclo., Ichth., 1788, 140 (Jamaica; based on Sloane).

Thynnus mediterraneus Risso, Hist. Nat. Princ. Prod. l'Europe, III, 1826, 414 (Nice).

Thynnus vulgaris Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 58, Pl. CCX (European Seas).

Thynnus brachypterus Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 98, Pl. CCXI (Mediterranean).

Thynnus coretta Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 102 (Caribbean Sea).

Scomber sloanei Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 148 (Jamaica).

Thynnus secundo-dorsalis Storer, Fishes Massachusetts, 1867, 66, Pl. XII, fig. 4 (Cape Ann and Provincetown).

Orcynus schlegelii Steindachner & Döderlein, Beitr. zur Kennt. der Fische Japan, III, 1885, 11, Pl. III, fig. 1 (Tokio).

Orcynus thynnus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 429.

Albacora thynnus Dresslar & Fesler, Bull. U. S. Fish. Comm., VII, 1887 (1889), 439.

Thunnus thynnus Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 870.

Head 3.28; depth 4.05; D. XIV-14-IX; A. 11-VIII.

Body oblong, rather deep, compressed, rather robust; dorsal and ventral outlines about evenly curved; head large; snout pointed, its length 3.15 in head; eye 5.85; mouth moderate, oblique; jaws subequal; maxillary reaching anterior margin of pupil, 2.56 in head; teeth in jaws small, in a single series; those on vomer and palatines in villiform bands; gill-rakers slender, nearly as long as eye, 28 on lower limb of first arch; lateral line without a distinct curve, with a feeble keel on caudal peduncle; body wholly covered with scales, those of corselet notably larger than the rest; first dorsal with 14 spines, the anterior ones rather high, about as long as snout and half of eye; second dorsal and anal similar, the anterior rays moderately elevated, each with 8 or 9 finlets; caudal very broadly forked; ventrals of moderate length, as long as longest dorsal spine; pectorals rather long, 1.6 in head.

Color bluish above; grayish below, with silvery streaks and spots.

This species was not taken by us. It is here described from a single specimen from Woods Hole, Massachusetts, which measures 665 mm. in length.

Known from all warm seas; not recorded from either coast of Panama.

94. Genus **Germo** Jordan.

Orcynus Cuvier, Règne Animal, Ed. I, II, 1817, 314 (type *Scomber germon* Lacépède=*Scomber alalunga* Gmelin; name preoccupied).

Germo Jordan, Proc. Ac. Nat. Sci. Phila., 1888, 180 (type *Scomber alalunga* Gmelin).

Body short, very robust, slightly compressed; head rather large, tapering strongly to pointed snout; mouth moderate; maxillary not concealed by preorbital; teeth small, in a single series on jaws, in villiform bands on vomer and palatines; gill-rakers of moderate length, rather numerous; lateral line without a distinct arch or curve; a well developed keel on caudal peduncle; scales small, covering entire body; corselet indistinct; first dorsal with 14 spines; interval between dorsal fins short; second dorsal and anal each followed by 7 or 8 finlets; ventrals rather small; pectorals extremely long, much longer than head in adult, from 2.3 to 3.0 in length of body, inserted on level with about middle of eyes.

239. Germo alalunga (Gmelin).

Ala-lunga Cetti, Hist. Nat. Sard., III, 1777, 191 (Sardinia).

Scomber alatunga Gmelin, Syst. Nat., 1789, 1330 (based on Cetti; misprint for *"alalunga"*).

Scomber germo Lacépède, Hist. Nat. Poiss., II, 1800, 598 (17° S. lat.; 103° W. long.).

Thynnus atlanticus Lesson, Voy. Coquille, Zoöl., II, 1828, 165 (Atlantic Ocean).

Thynnus balteatus Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 136 (Tropical parts of Atlantic).

Thynnus pacificus Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 133 (26° and 27° S. lat.; 103° W. long.).

Thynnus argenti-vittatus Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 134 (Atlantic and the Indies).

Thynnus albacora Lowe, Proc. Zoöl. Soc. London, 1839, 77 (Madeira).

Thynnus macropterus Temminck & Schlegel, Fauna Japon., Pisces, 1850, 98, Pl. LI (Japan).

Orcynus subulatus Poey, Enumeratio, 1875, 71 (Cuba).

Orcynus alalonga Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 428.

Albacora alalonga Dresslar & Fesler, Bull. U. S. Fish. Comm., VII, 1887 (1889), 438.

Germo alalunga Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 871, Pl. CXXXIV, fig. 367.

Head 3.15 to 3.3; depth 4.3; D. XIV-13 or 14-VIII; A. II-13 or 14-VII.

Body rather short, very robust, slightly compressed; head large; snout rather short and sharply pointed, its length 3.05 to 3.2 in head; eye 4.45 to 5.1; mouth rather small, little oblique; jaws subequal; maxillary reaching slightly past anterior margin of the large eye, 2.7 to 2.8 in head; teeth small, those on jaws in a single series, those on vomer and palatines in villiform bands; gill-rakers slightly more than half the length of eye, 22 on lower limb of first arch; lateral line without distinct arch or curve; a well developed keel on caudal peduncle; entire body covered with small scales; corselet indistinct; first dorsal with 14 spines, the anterior ones the longest, slightly longer than the snout, the posterior ones very short, contiguous to soft dorsal; second dorsal and anal similar, very small, each followed by 7 or 8 finlets; caudal very broadly forked; ventral small, about as long as snout; pectorals extremely long, much longer than head, 2.3 to 3.0 in length of body.

Color in spirits bluish or brownish above, silvery below; sides below lateral line with rather indistinct, pale, longitudinal streaks.

This species was not taken by us. Here described from a well preserved specimen, 580 mm. in length, from Chile and from a skin, about 825 mm. in length, from Santa Barbara, California.

A pelagic species, recorded from all tropical seas, but not from either coast of Panama.

95. Genus **Sarda** Cuvier.

Sarda Cuvier, Règne Anim., Ed. II, II, 1829, 199 (type *Scomber sarda* Bloch).

Pelamys Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 149 (type *Scomber sarda* Bloch; name preoccupied).

Body elongate, somewhat compressed; head large, pointed; mouth large; maxillary not concealed by preorbital; teeth on jaws rather strong, slightly compressed, similar teeth on palatines, none on vomer and tongue; gill-rakers rather short and few in number; scales small, those of pectoral region forming a distinct corselet; caudal peduncle with a distinct keel in lateral line, and a very feeble one above and below it; first dorsal with 18 to 22 rather strong spines, gradually shortened behind; interval between dorsal fins slight; second dorsal and anal similar, each followed by from 6 to 9 detached finlets; caudal broadly forked; ventrals and pectorals small, the latter inserted slightly above the level of lower margin of eyes.

KEY TO THE SPECIES.

a. Gill-rakers long, the longest equal to length of eye, 16 or 17 on lower limb of first arch; first dorsal with 18 or 19 spines; maxillary posteriorly broad and rounded, reaching posterior margin of eye, 2.0 to 2.16 in head. *chilensis*, p. 318.

aa. Gill-rakers of moderate length, about three-fourths length of eye, 12 to 14 on lower limb of first arch; first dorsal with 20 or 21 spines; maxillary posteriorly broad and rounded, reaching to or slightly past posterior margin of eye, 1.95 to 2.04 in head. *sarda*, p. 319.

aaa. Gill-rakers short, the longest scarcely two-thirds the length of of eye, 9 on lower limb of first arch; first dorsal with 18 spines; maxillary posteriorly only slightly broadened, reaching notably beyond eye, 1.88 in head. *velox* sp. nov., p. 320.

240. Sarda chilensis (Cuvier & Valenciennes).

Pelamys chilensis Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 163 (Valparaiso, Chile).

Pelamys orientalis Temminck & Schlegel, Fauna Japon., Pisces. 1850, 99, Pl. LII (Japan).

Pelamys lineolata Girard, (House of Repr. Ex. Doc. No. 91) Rept. Expl. & Surv. Miss. R. to Pac. O., X, Pt. IV, 1858, 106 (San Diego, Cal.).

Sarda chilensis Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 428; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 872; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 68.

Head 3.27 to 3.85; depth 4.3 to 5.15; D. XVIII or XIX-13 to 15-VIII or IX; A. II, 11 to 13.

Body elongate, rather slender, compressed; dorsal and ventral outlines about evenly curved; head long, compressed; snout pointed, its length 2.95 to 3.25 in head; eye 5.6 to 7.2; mouth large, slightly oblique; jaws subequal; maxillary rather long, broad and rounded posteriorly, reaching posterior margin of eye, 2.0 to 2.16 in head; teeth on jaws of about equal size, curved inward, from 36 to 50 on each jaw; gill-rakers rather numerous, usually about as long as eye, 16 or 17 on lower limb of first arch; lateral line slightly wavy, becoming horizontal under about the second dorsal finlet; moderately developed keel on caudal peduncle; first dorsal with 18 or 19 spines, the anterior ones long and slender, usually slightly longer than snout; second dorsal and anal similar, more or less falcate, their outer margin notably concave, the latter inserted under or slightly behind last rays of dorsal, each with 6

to 9 detached finlets; ventral small, somewhat shorter than snout; pectorals short, 2.04 to 2.65 in head.

Color bluish above, pale or silvery below; back and sides with about 5 dark lines running obliquely backward and upward; ventrals and anal pale, other fins with more or less dusky. Specimens from southern localities are darker than those from more northern waters.

This species was not taken by us. It is here described from 8 specimens from Santa Barbara, California, and Callao, Peru, ranging in length from 270 to 675 mm.

Its relationship is close to *Sarda sarda*, its Atlantic congener, from which it differs mainly in the fewer dorsal spines, and more numerous gill-rakers.

Known from the Pacific; on the American coast from San Francisco to Chile. Also recorded from Japan. Recorded from Panama by Gilbert & Starks (1904).

241. Sarda sarda (Bloch).

Scomber pelamys Brünnich, Ichth. Massil., 1768, 69 (Marseilles; not of Linnæus).

Scomber sarda Bloch, Ichthyol., X, 1793, 35, Pl. CCCXXXIV (Europe).

Scomber mediterraneus Bloch & Schneider, Syst. Ichth., 1801, 23 (Marseilles; after Brünnich).

Scomber pelamitus Rafinesque, Caratteri, etc., 1810, 44, Pl. II (Palermo).

Pelamys sarda Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 149, Pl. CCVII.

Sarda mediterraneus Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 427.

Sarda sarda Dresslar & Fesler, Bull. U. S. Fish. Comm., VII, 1887 (1889), 440, Pl. VIII; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 872.

Head 3.45 to 3.7; depth 4.4 to 5.4; D. XX or XXI-14 to 17-VIII or IX; A. II, 11 to 13-VI to VIII.

Body elongate, rather slender, compressed; dorsal and ventral outlines about evenly curved; head long, compressed; snout pointed, its length 2.95 to 3.2 in head; eye 5.12 to 6.65; mouth large, slightly oblique; upper jaw very slightly in advance of lower; maxillary long, rounded posteriorly, reaching to or past posterior margin of eye, 1.95 to 2.04 in head; teeth on jaws of about equal size, curved inward, from 28 to 44 on each jaw; gill-rakers in moderate num-

bers, about three-fourths the length of eye, 12 to 14 on lower limb of first arch; lateral line wavy, becoming horizontal under second dorsal finlet; a prominent keel on caudal peduncle; first dorsal with 20 or 21 spines, the anterior ones about the length of snout; second dorsal and anal similar, falcate in adult, scarcely so in young, the latter inserted under first dorsal finlet, each fin with from 6 to 9 detached finlets; ventrals small, somewhat shorter than snout; pectorals short, 2.2 to 3.2 in head.

Color bluish above, silvery below; back and sides in adult with 6 to 8 black stripes, running backward and slightly upward to back; young with more or less distinct cross-bars above lateral line, and without black longitudinal stripes.

This species was not taken by us. We have examined specimens from the Mediterranean, Massachusetts, Rhode Island, New York, and Maryland, ranging in length from 145 to 615 mm.

A pelagic species inhabiting the Atlantic Ocean. It has been taken on both coasts of the Atlantic. There appears, however, as yet to be no Central or South American record.

242. Sarda velox sp. nov. (Plate XXIV.)

Type No. 81060, U. S. N. M.; length 410 mm.; Panama City, Panama.

Head 3.24; depth 4.1; D. XVIII-16-VIII; A. II, 12-VII.

Body elongate, robust, somewhat compressed; the ventral and dorsal outlines evenly curved; head long, compressed; snout pointed, its length 3.0 in head; eye 6.55; mouth very large, slightly oblique; jaws subequal; maxillary long, only slightly broadened posteriorly, reaching well beyond posterior margin of eye, 1.88 in head; teeth in upper jaw of moderate size, curved inward, about 40 in number, those in lower jaw similar but larger, about 22 in number; gill-rakers rather few and short, the longest about two-thirds the length of eye, 9 on lower limb of first arch; lateral line very slightly arched anteriorly, becoming horizontal under the third dorsal finlet; a rather prominent keel on caudal peduncle; first dorsal with 18 spines, the anterior ones rather high, about as long as snout; second dorsal and anal similar, their margin deeply concave, the latter inserted under about the last ray of dorsal, each with 7 or 8 detached finlets; ventrals rather small, scarcely as long as snout; pectorals short, 2.4 in head.

Color very dark blue above, brownish or silvery below; back with 4 or 5 black longitudinal stripes; opercle and preopercle with

SARDA VELOX sp. nov.
From the type 410 mm. in length.

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narrow, alternating, dark brown and paler stripes; upper surface of head and a narrow region about spinous dorsal black; ventral fins pale on outside, orange brown on inside; other fins all black or with more or less dusky.

We preserved but a single specimen 410 mm. in length. Fishes of this genus were abundant in the Panama market for a short time during the middle of January, 1912, and then suddenly disappeared and were not again seen. The present species differs from its near relative, *S. chilensis,* notably in the fewer and shorter gill-rakers; in the longer and slightly differently shaped maxillary, and in the more robust and deeper body.

Our specimen was purchased in the Panama City market.

96. Genus **Scomberomorus** Lacépède.

Scomberomorus Lacépède, Hist. Nat., Poiss., III, 1802, 292 (type *Scomberomorus plumieri* Lacépède=*Scomber regalis* Bloch).

Polipturus Rafinesque, Analyse Nat., etc., 1815, 84 (substitute for *Scomberomorus*).

Cybium Cuvier, Règne Animal, Ed. II, II, 1829, 199 (type *Scomber commersonii* Lacépède).

Chriomitra Lockington, Proc. Ac. Nat. Sci. Phila., 1879, 133 (type *Chriomitra concolor* Lockington).

Body elongate, more or less compressed; head rather low; snout rather long and pointed; mouth large; maxillary not concealed by the preorbital; teeth in jaws rather strong, compressed, more or less triangular, with sharp cutting edges; vomer and palatines with granular teeth; gill-rakers rather short and few in number; scales small, rudimentary, not forming a corselet; caudal peduncle with a rather prominent keel in lateral line and a feeble one above and below it; first dorsal with 14 to 18 feeble spines; interval between dorsal fins slight; second dorsal and anal each followed by 7 to 10 finlets; ventrals small; pectorals moderate, inserted near the level of eyes; alimentary canal short; air bladder present.

KEY TO THE SPECIES.

a. Body very slender, its depth 5.5 to 6.25 in its length; gill-rakers extremely short, not more than one-fourth the length of eye in adult, 7 or 8 more or less developed on lower limb of first arch; lateral line with an abrupt downward curve under second dorsal; sides in adult plain silvery, without spots or streaks, in young with yellowish spots. *cavalla*, p. 322.

aa. Body deeper, its depth usually less than 5.5 in its length; gill-rakers longer and more numerous, not fewer than 10 on lower limb of first arch; lateral line descending gradually, not with an abrupt curve.

b. Gill-rakers about half the length of eye in adult, 10 to 12 more or less developed on lower limb of first arch; sides with bronzy spots or dark streaks in both sexes and at all ages.

c. Pectorals almost wholly covered with small scales; sides with one or two longitudinal dark streaks and a few rows of elliptical spots. *regalis*, p. 323.

cc. Pectorals without scales; sides with bronzy spots, but without dark streaks. *maculatus*, p. 324.

bb. Gill-rakers long and slender, only slightly shorter than eye in adult, 16 to 18 on lower limb of first arch; sides in male plain silvery; female with brown spots. *concolor*, p. 325.

243. Scomberomorus cavalla (Cuvier).

Cybium cavalla Cuvier, Règne Animal, Ed. II, II, 1829, 200 (Brazil).

Cybium caballa Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 187 (Brazil).

Cybium immaculatum Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 191 (no locality).

Scomberomorus caballa Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 427.

Scomberomorus cavalla Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 235; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 875.

Head 4.25 to 4.55; depth 5.5 to 6.25; D. XIV-17-IX; A. II, 14 to 17-IX or X.

Body elongate, slender, little compressed; the back scarcely elevated; ventral outline slightly more rounded than the dorsal; head long and low; snout pointed, its length 2.45 to 2.5 in head; eye 5.0 to 5.85; mouth large, oblique; jaws subequal; maxillary reaching to or slightly past posterior margin of eye, 1.65 in head; teeth compressed, wide at base, triangular, 40 to 44 on each jaw; gill-rakers very short, about one-fourth the length of eye in adult, 7 or 8 on the lower limb of first arch; lateral line with an abrupt downward curve under origin of second dorsal; dermal keel on caudal peduncle rather large; first dorsal with very weak spines; second dorsal and anal similar, densely scaled, each with IX or X detached finlets; origin

of second dorsal in advance of anal; ventrals notably longer than eye and shorter than snout in adult; pectorals of moderate length, without scales, 1.62 to 1.7 in head.

Color plain bluish above, pale below; no markings of any kind on specimens at hand. The young are said to possess yellowish spots. Spinous dorsal mostly pale; other fins pale or with more or less dusky.

This species was not taken by us. It is here described from 2 large specimens from Jamaica, respectively 635 and 675 mm. in length.

Known on the Atlantic coast of America from Massachusetts to Brazil. It is also reported from Africa, but not as yet from Panama.

244. Scomberomorus regalis (Bloch).

Scomber regalis Bloch, Ichthyol., 1795, Pl. CCCXXXIII (Martinique; after a drawing by Plumier).

Scomberomorus plumieri Lacépède, Hist. Nat. Poiss., III, 1802, 292 (Martinique; after Aubriet's copy of Plumier's drawing).

Cybium regale Cuvier, Règne Animal, Ed. II, II, 1829, 121.

Cybium acervum Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 186 (Cuba).

Scomberomorus regalis Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 426; Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 234; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 875, Pl. CXXXV, fig. 369.

Head 4.2 to 4.25; depth 4.8 to 5.5; D. XVII-16-VIII or IX; A. II, 14 or 15-VIII.

Body elongate, compressed; the back scarcely elevated; the ventral outline more strongly curved than the dorsal; head rather long and low; snout pointed, its length 2.4 to 2.56 in head; eye 5.15 to 5.88; mouth large, oblique; maxillary reaching posterior margin of eye, 1.7 to 1.75 in head; teeth in specimens at hand rather wide at base, triangular, compressed, 30 to 34 on each jaw; gill-rakers in adult scarcely half the length of eye, 11 or 12 on the lower limb of first arch; lateral line descending obliquely under base of second dorsal, becoming horizontal under the first dorsal finlet; dermal keel on caudal peduncle large; first dorsal with slender spines; second dorsal and anal similar, densely scaled, each with 8 or 9 finlets; origin of second dorsal slightly in advance of anal; ventral fins longer than eye, but shorter than snout; pectorals of moderate length, densely scaled, 1.7 to 1.85 in head.

Color bluish above, silvery below. Preserved specimens at hand, each with a continuous dark streak from base of pectoral to near last

rays of dorsal, there breaking up into elliptical spots; above and below this streak a row of elliptical spots, the upper row sometimes more or less connected, forming a streak; spinous dorsal white at base, margin black; other fins pale or dusky in spirits.

This species was not taken by us. It is here described from 3 large specimens from Key West, ranging in length from 420 to 700 mm. This fish is very closely related to *S. maculatus*, from which it differs chiefly in color, and in having the pectoral fins densely scaled.

Known from Massachusetts southward to Brazil. Said to be very abundant in Cuba. Not recorded from Panama.

245. Scomberomorus maculatus (Mitchill).

Scomber maculatus Mitchill, Trans. Lit. & Phil. Soc. N. Y., I, 1815, 426 (New York).

Cybium maculatum Cuvier, Règne Animal, Ed. II, II, 1829, 121; Agassiz, in Spix, Pisc. Brasil., 1831, 103, Pl. LX; Günther, Cat. Fish. Brit. Mus., II, 1860, 372.

Scomberomorus maculatus Jordan & Gilbert, Bull. U. S. Fish. Comm., II, 1882 (1883), 106; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 426; Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 233; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 874, Pl. CXXXIV, fig. 368.

Scomberomorus sierra Jordan & Starks, Proc. Cal. Ac. Sci., 2nd Ser., V, 1895, 428 (Mazatlan); Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 68; Snodgrass & Heller, Proc. Wash. Ac. Sci., V, 1905, 361; Kendall & Radcliffe, Memoir. Mus. Comp. Zoöl., XXXV, 1912, 96.

Head 3.4 to 4.8; depth 4.35 to 5.7; D. XVII or XVIII-15 to 18-VIII or IX; A. II, 15 to 17-VIII or IX.

Body elongate, compressed; the back little elevated; dorsal and ventral outlines about evenly rounded; head rather long and low; snout sharply pointed, its length 2.6 to 3.07 in head; eye 4.46 to 6.02; mouth large, slightly oblique; jaws subequal in adult, the upper one protruding in very young; maxillary long, rounded posteriorly, reaching posterior margin of eye, 1.65 to 1.8 in head; teeth in jaws compressed, very variable in size and number, from 24 to 50 in each jaw; gill-rakers slightly more than half the length of eye in adult, very short or even rudimentary in very young, 10 to 12 on lower limb of first arch; lateral line wavy, descending obliquely, becoming horizontal under last rays of dorsal; dermal keel on caudal peduncle small; first dorsal with slender spines; second dorsal and anal similar, densely scaled,

each with 7 to 9 detached finlets; origin of second dorsal over or in advance of anal; ventrals small, equal to length of eye in young, longer than eye in adult; pectorals extremely short in very young, proportionately much longer in adult, not covered with scales, 1.6 to 3.2 in head.

Color of back bluish green, with waves of darker and brighter color; sides silvery, washed with brown, with 4 irregular rows of yellow spots, extending from pectorals to about the third finlet back of dorsal and anal; body with 2 blackish vertical bands, the first one passing around the body between the fifth and sixth dorsal spines, the second one, a wider and more distinct one, passes around the body at origin of second dorsal and anal; these bands only occasionally present; spinous dorsal pale at base, otherwise black; soft dorsal, its finlets, and caudal bluish black, with green at base; anal and its finlets yellowish, with dark points; ventrals pale; pectorals mostly dark green, with black tip. The above color description is based on a fresh specimen taken in the Panama market.

We have 24 specimens of this species from the Pacific, which range in length from 22 to 485 mm. From the Atlantic we have 48 specimens, which range in length from 65 to 320 mm.

We are unable to separate the specimens from the opposite coasts. As already stated by Gilbert & Starks (1904), the backward position of the second dorsal, which has been given as the chief character to distinguish the Pacific coast form from *S. maculatus,* is absolutely of no value. The variation with respect to the size and number of jaw teeth is remarkable, but apparently of no specific value.

On the Pacific coast known from Cortez Banks south to the Galapagos Islands; on the Atlantic coast from Maine to Brazil. Our Pacific coast specimens are from Chame Point, Naos Island, Balboa, and the Panama City market. The Atlantic coast specimens are from Mindi Cut; Fox Bay, Colon, and Colon market.

246. Scomberomorus concolor (Lockington).

Chriomitra concolor Lockington, Proc. Ac. Nat. Sci. Phila., 1879, 134 (Monterey Bay, Cal.).

Scomberomorus concolor Jordan & Gilbert, Proc. U. S. Nat. Mus.., 1881, 45; Meek & Newland, Proc. Ac. Nat. Sci. Phila., 1884, 233; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 873.

Cybium concolor Boulenger, Boll. Mus. Zoöl. Anat. Torino, XIV, No. 346, 1899, 3 (Panama Bay).

Head 4.77 to 5.15; depth 4.3 to 4.5; D. XVII-16 to 18-VIII or IX; A. II, 16 to 18-VII or VIII.

Body robust, rather deep, not greatly compressed; back somewhat elevated; dorsal and ventral outlines about evenly rounded; head rather deep; snout sharply pointed, its length 2.8 to 2.9 in head; eye 5.6 to 6.3; mouth large, oblique; maxillary reaching posterior margin of eye, 1.77 to 1.8 in head; teeth small, compressed, rather narrow at base, scarcely triangular, 44 to 66 in each jaw; gill-rakers rather long and slender, slightly shorter than eye, 16 to 18 on lower limb of first arch; lateral line slightly wavy, descending obliquely and very gradually, becoming horizontal under about the third dorsal finlet; keel on caudal peduncle moderately developed; first dorsal with very weak, slender spines; second dorsal and anal similar, densely scaled; origin of dorsal slightly in advance of anal; ventrals short, not much longer than eye; pectorals of moderate length, without scales, 1.5 to 1.75 in head.

Color plain bluish above, silvery below; no markings of any kind on specimens at hand; fins all nearly plain brown or dusky. The female is said to have two alternate series of brown spots on sides.

This species was not taken by us. It is here described from 4 large specimens from Soquel, California, ranging from 570 to 615 mm. in length.

Known from Monterey Bay, California. Recorded from Panama Bay by Boulenger (1899); not seen by other observers.

97. Genus **Acanthocybium** Gill.

Acanthocybium Gill, Proc. Ac. Nat. Sci. Phila., 1862, 125 (type *Cybium sara* Bennett).

Body elongate, fusiform; head long and low, tapering gradually to the long beak-like snout; mouth large; maxillary posteriorly concealed by preorbital; teeth on jaws rather strong, compressed, slightly ovate; vomer and palatines with large patches of villiform teeth; lateral line with a strongly developed keel on caudal peduncle; scales small, covering entire body, corselet indistinct; first dorsal very long, with 26 spines; interval between dorsal fins slight; second dorsal and anal each followed by about 9 finlets; ventrals small; pectorals moderate.

247. **Acanthocybium solandri** (Cuvier & Valenciennes).

Cybium solandri Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 1831, 192 (After MSS. of Solander; open sea; exact locality unknown).

Cybium sara Lay & Bennett, Zoöl. Beechey's Voyage, Fishes, 1839, 63, Pl. XX, fig. 2 (Loo Choo).

Cybium petus Poey, Memorias, II, 1860, 234, Pl. XVI, fig. 1 (Havana).

Acanthocybium petus Poey, Syn. Pisc. Cub., 1868, 363.

Cybium verany Doderlein, Giorn. di Sc. Nat., Ed. Econ., VIII, 1872, 1 (Palermo).

Acanthocybium solandri Jordan, Proc. U. S. Nat. Mus., 1884, 119; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 876.

Head about 3.6; depth about 6.4; D. XXVI-12-IX; A. II, 10-IX.

Body very elongate, fusiform; the back little elevated; head long and low; snout extremely long, beak-like, its length 1.95 in head; eye 9.7; mouth large, slightly oblique; the lower jaw slightly in advance of the upper; maxillary reaching anterior margin of pupil, 1.94 in head; teeth in jaws compressed, more or less ovate; vomer and palatines with large patches of villiform teeth; lateral line with a rather strongly developed keel on caudal peduncle; entire body covered with small scales; corselet indistinct; first dorsal very long, with 26 rather slender spines; second dorsal and anal similar, small, somewhat elevated anteriorly, each with 9 finlets; caudal very broadly forked; ventrals rather small, less than half the length of snout; pectorals moderate, 1.94 in head.

Color dark above, paler below; snout and upper surface of head steel-blue or black.

This species was not taken by us. It is here described from a skin from Key West, 1200 mm. in length.

A pelagic species, recorded from nearly all warm seas, but not yet reported from either coast of Panama.

Family XLII. **Trichiuridæ.**

The Cutlass-fishes.

Body elongate, strongly compressed, band-shaped, the tail tapering to a point; head long, compressed; snout more or less beak-like; mouth large; lower jaw projecting; premaxillaries not protractile; pseudobranchiæ present; gills 4, a slit behind the fourth; gill-membranes separate, free from the isthmus; teeth on jaws strong, unequal; lateral line continuous; scales wanting; dorsal fin very long; caudal fin wanting; anal long and very low, composed of separate spines which scarcely rise above the skin; ventrals thoracic, rudimentary or wanting; air bladder present; vertebræ about 160.

98. Genus **Trichiurus** Linnæus.

Trichiurus Linnæus, Syst. Nat., Ed. X, 1758, 246 (type *Trichiurus lepturus* Linnæus).

Gymnogaster Gronow, Zoophyl., 1763, 136 (type *Trichiurus lepturus* Linnæus).

Enchelyopus Klein, Neuer Schauplatz, etc., I, 1775, 32 (type *Trichiurus lepturus* Linnæus).

Lepturus Gill, Proc. Ac. Nat. Sci. Phila., 1862, 126 (type *Trichiurus lepturus* Linnæus).

Ventral fins wanting. Other characters are included in the family description.

248. **Trichiurus lepturus** Linnæus.

Trichiurus lepturus Linnæus, Syst. Nat., Ed. X, 1758, 246 (America; after *Lepturus* of Artedi); Günther, Cat. Fish. Brit. Mus., II, 1860, 346; Jordan & Gilbert, Bull. U. S. Nat. Mus., XVI, 1883, 422; Jordan & Bollman, Proc. U. S. Nat. Mus., 1889, 180 (Panama); Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 889, Pl. CXXXVII, fig. 375; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 70.

Trichiurus argenteus Shaw, Gen. Zoöl., IV, 1803, 90, Pl. XII (after Linnæus).

Lepturus lepturus Poey, Enumeratio, 1875, 94.

Head 6.8 to 8.8 in total length; depth 13 to 18; D. 120 to 137; A. 94 to 110.

Body extremely elongate, compressed, band-like; tail slender, tapering to a point; head long, compressed; snout beak-like, its length 2.6 to 2.9 in head; eye 5.35 to 6.3; mouth large; lower jaw strongly projecting; maxillary posteriorly concealed by the preorbital, reaching about anterior margin of pupil, 2.2 to 2.7 in head; teeth in the jaws strong and unequal, compressed, the largest ones with a distinct barb on the posterior edge; vomer toothless; palatines with a very narrow band of villiform teeth; gill-rakers poorly developed and of unequal length, from 5 to 15 more or less developed on the lower limb of first arch; lateral line directed obliquely downward anteriorly, running low on the body, and following the curvature of the belly; scales wanting; dorsal fin extremely long, beginning over the indistinct margin of preopercle and occupying the whole length of the back; anal with very short detached spines, anteriorly directed backward, posteriorly forward; ventral fins wanting; pectorals small, 2.0 to 3.3 in head.

Color uniformly bright silvery; dorsal with more or less dusky on its margin.

We have 11 specimens of this species from the Atlantic, ranging in length from 300 to 870 mm. From the Pacific we have a single specimen 360 mm. in length. Besides the ones taken by us we have examined a specimen from Panama taken by the Albatross, one specimen from Guatemala, and one small specimen from Lower California. The Pacific coast specimens average fewer dorsal rays, the range for the 4 specimens at hand being 120 to 128, average 122.5; the range for 10 Atlantic specimens is 126 to 137, average 132.9. The maxillary of the Pacific coast specimens appears to be slightly shorter, ranging 2.5 to 2.7 in head; the range for 10 Atlantic coast specimens is 2.2 to 2.5. To determine definitely the exact relationship, a larger series of specimens from the Pacific coast is necessary.

Widely distributed in warm seas. Occurring on both coasts of tropical America. Our Atlantic coast specimens are from Mindi Cut and Colon market. The Pacific coast specimen is from Chame Point.

Family XLIII. Nematistiidæ.

The Papagallos.

Body oblong, deep anteriorly, rather strongly depressed; head short and blunt, little longer than high, its upper profile strongly convex; eyes placed high, near the snout and upper profile; mouth large, oblique; the maxillary reaching well past anterior margin of eye; teeth small, in villiform bands on jaws, vomer and palatines; opercle unarmed; branchiostegals 6; gill-rakers well developed; scales small, cycloid; lateral line well developed, without a prominent arch, and unarmed; dorsal fins 2, each with a very high sheath at the base; the first dorsal with 8 spines, all except the first one produced into long filamentous spines; second dorsal long and low; caudal fin forked; anal low and shorter than second dorsal, with 2 short spines; ventral fins large, inserted under the bases of the pectorals, with I, 5 rays; pectoral fins long and falcate in adult. Only one species known.

99. Genus **Nematistius** Gill.

Nematistius Gill, Proc. Ac. Nat. Sci. Phila., 1862, 258 (type *Nematistius pectoralis* Gill).

The characters of the genus are included in the family description.

This genus is closely allied to *Seriola,* from which it, however, differs notably in the prolongation of the dorsal spines and pectoral fins.

249. Nematistius pectoralis Gill.

Nematistius pectoralis Gill, Proc. Ac. Nat. Sci. Phila., 1862, 259 (Cape San Lucas); Steindachner, (Sitzb. k. Ak. Wiss. Wien, LXXII) Ichth. Beitr., IV, 1875, 11; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 277; Jordan, Proc. U. S. Nat. Mus., 1885, 375; Jordan & Evermann, Bull. U. S. Nat. Mus., XLVII, 1896, 895, Pl. CXXXVIII, fig. 377; Gilbert & Starks, Memoir. Cal. Ac. Sci., IV, 1904, 70.

Head 3.32 to 3.7; depth 2.9 to 3.25; D. VIII-I, 26 or 27; A. II, 16 or 17; scales about 130.

Body deep, much compressed; the back elevated; anterior profile strongly convex; head short and deep; snout very blunt, 3.6 to 4.3 in head; eye 3.1 to 4.3; mouth large; jaws subequal; maxillary broad, reaching nearly to posterior margin of eye, 1.95 to 2.1 in head; teeth small, in villiform bands, present on jaws, vomer and palatines; gill-rakers well developed, 9 or 10 on lower limb of first arch; scales small, present on head and body; snout mostly naked; lateral line with a long, low arch, becoming horizontal above middle of base of anal, unarmed; dorsal and anal with a high sheath of scales at base; the first dorsal with 8 spines, all except the first one much produced, bearing long filaments; second dorsal long and low; caudal fin forked; anal fin with 2 short spines, and 16 or 17 soft rays; ventral fins inserted under base of pectorals, rather large; pectoral fins long and falcate, longer than head in adult, shorter than head in young, 2.8 to 4.9 in length of body.

Color grayish green above, silvery below; snout with a dark band; another on forehead, from eye to eye; a third one from nape across opercle; a fourth one at origin of spinous dorsal, running downward and backward; a fifth one under posterior spines of first dorsal; back of this one are 3 black blotches, the last one being at base of caudal; dorsal filaments with alternating black and pale bars; second dorsal with indistinct alternating black and pale bars; other fins black and white, without distinct bars.

There are 4 small specimens, 50 to 200 mm. in length, in the present collection. Three of these were sent by Mr. Robert Tweedlie.

Known from Gulf of California south to Panama. Our specimens are from Chame Point.

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